The Engineer

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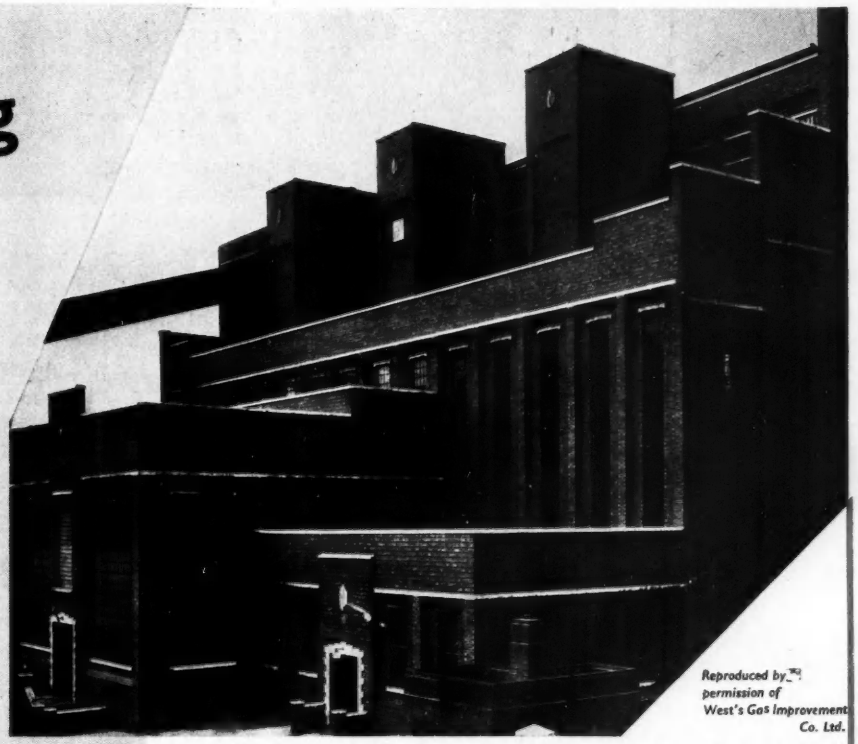

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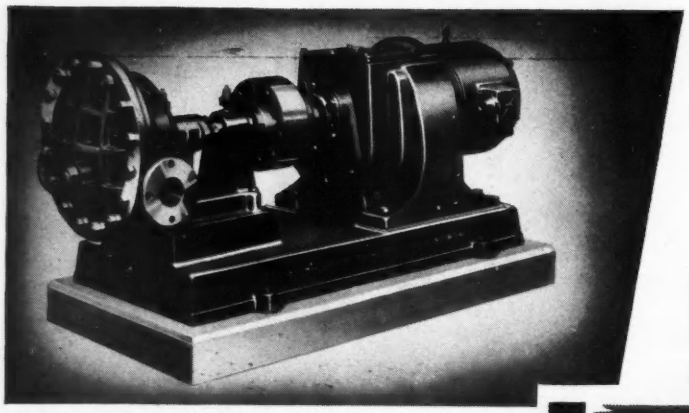

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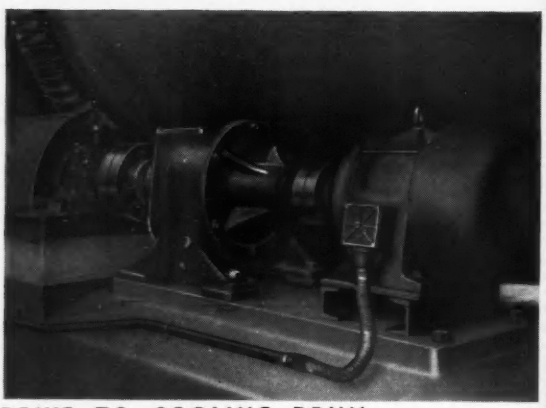

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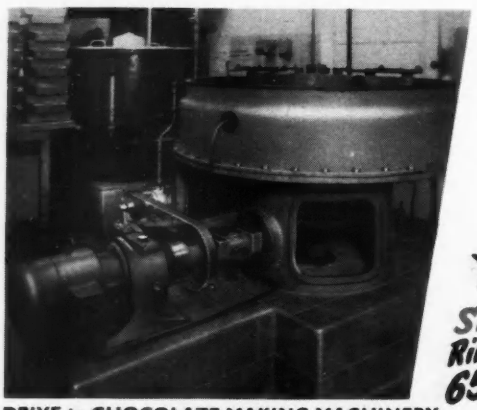

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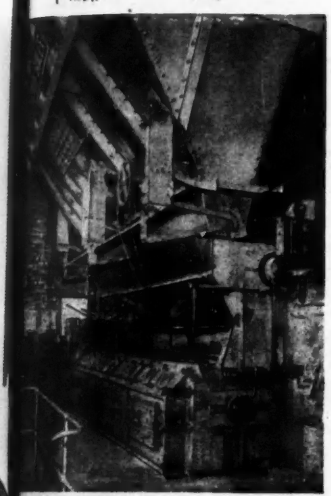

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THE ENGINEER

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NOTICE TO READERS
All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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PUBLIC APPOINTMENTS

UNIVERSITY OF NOTTINGHAM

DEPARTMENT OF MECHANICAL ENGINEERING

READER OR LECTURER (GRADE I) IN METALLURGY

Applications are invited for appointment as READER or LECTURER (GRADE I) IN METALLURGY. Candidates must have had teaching, research and practical experience. Salary scales : Reader, £1100 to £1600 ; Lecturer, £1100 to £1300.

The conditions of appointment and form of application may be obtained from the undersigned, to whom applications must be sent not later than 16th May, 1953.

H. PICKBOURNE,
Registrar.

E8305

UNIVERSITY OF NOTTINGHAM

DEPARTMENT OF CIVIL ENGINEERING

READER OR SENIOR LECTURER IN CIVIL ENGINEERING

Applications are invited for appointment as READER or SENIOR LECTURER IN CIVIL ENGINEERING. Candidates should have had teaching, research and practical experience. Salary within the range £1100 to £1600.

The conditions of appointment and form of application may be obtained from the undersigned, to whom applications must be sent not later than 16th May, 1953.

H. PICKBOURNE,
Registrar.

E8306

THE UNIVERSITY OF MANCHESTER

TWO LECTURESHIPS IN ENGINEERING

Applications are invited for two LECTURESHIPS IN ENGINEERING. Candidates should have special qualifications in mechanical engineering with particular interest in one or more of the following :—Fluid mechanics and heat transfer, thermodynamics applied to heat engines, theory of machines, the engineering of chemical processes. Salary scale £500–£1100 per annum, with membership of F.S.S.U. and children's allowance scheme. Initial salary according to qualifications and experience.—Applications should be sent not later than 16th May, 1953, to the Registrar, The University, Manchester, 13, from whom further particulars and forms of application may be obtained.

E8332

NOTTINGHAM UNIVERSITY

MECHANICAL ENGINEERING DEPARTMENT

RESEARCH FELLOWSHIP

Applications are invited for a RESEARCH FELLOWSHIP in MECHANICAL ENGINEERING, valued at £500 per annum, plus fees.

Applicants should have a good Honours Degree in Engineering, Physics or Applied Mathematics, practical experience and/or research training.

Conditions of award and form of application, which should be returned as soon as possible, may be obtained from the undersigned.

H. PICKBOURNE,
Registrar.

E8367

COUNTY BOROUGH OF READING

READING TECHNICAL COLLEGE

GRADE B ASSISTANT

Applications are invited for the post of Grade B ASSISTANT to teach engineering science, mathematics and drawing. Electrical or Mechanical Degree or equivalent and some industrial experience expected.

This is a new post to be taken up on 1st September, 1953. Salary in accordance with current Burnham Technical Report. Further particulars and forms obtainable from undersigned, to whom completed applications must be returned by 5th May, 1953.

P. S. TAYLOR,
Clerk to the Governors.

Education Office,
Blagrave Street,
Reading.

E8338

SURREY COUNTY COUNCIL

EDUCATION COMMITTEE

COUNTY TECHNICAL COLLEGE, STOKE PARK, GUILDFORD

ASSISTANT, GRADE A

Applications are invited for the post of ASSISTANT, Grade A, in the Engineering Dept., to commence duties on 1st September, 1953.

Candidates should be suitably qualified to teach subjects of the City and Guilds Course in Machine Shop Engineering up to Intermediate standard at least, and to assist with Mathematics, Engineering Science and Drawing in early stages of other courses.

Application form and further particulars may be obtained from the Principal on receipt of a stamped, addressed, foolscap envelope. They should be returned within two weeks of the appearance of this advertisement.

E8293

LEICESTERSHIRE EDUCATION COMMITTEE

HINCKLEY COLLEGE OF FURTHER EDUCATION

APPOINTMENT OF PRINCIPAL

Applications are invited for the post of PRINCIPAL, which falls vacant on December 31st, 1953.

Candidates must be Graduates or have equivalent qualifications. Experience in industry and in technical education is an advantage. The College has a special connection with the local hosiery industry and is a centre for the various educational activities of the district. There are good buildings, an active College Union and playing fields. A Principal with wide interests is required.

Salary £1190 by £15 to £1340.

Consideration will be given to registered disabled persons.

Apply (no form provided), with the names of two referees and copies of two testimonials, within twenty-one days to the Director of Education, County Offices, Grey Friars, Leicester.

E8266

THE COLLEGE OF AERONAUTICS

ENGLISH ELECTRIC RESEARCH

FELLOWSHIP IN AERONAUTICS

Applications are invited for a RESEARCH FELLOWSHIP which has been established at the College by the English Electric Co., Ltd. The Fellowship is intended to provide opportunity for post-graduate research into problems of vibration or stability and control of aircraft and is tenable for one year, beginning on or about 1st October, 1953. The value of the Fellowship is £500.

Applications, giving full particulars of education and experience and quoting the names of three referees, are required by 1st May, 1953, and should be addressed to the Warden, The College of Aeronautics, Cranfield, Bletchley, Bucks.

E8181

BIRKENHEAD EDUCATION COMMITTEE

ESTABLISHMENTS FOR FURTHER EDUCATION

FULL-TIME APPOINTMENTS

Applications are invited for the following full-time appointments :—

BIRKENHEAD TECHNICAL COLLEGE

(a) LECTURER in Mechanical Engineering (Strength of Materials, Theory of Machines, Theory of Structures, to H.N.C. and Degree).

(b) ASSISTANT, Grade A, for Electrical Engineering (to H.N.C. with some Mechanical to O.N.C.).

(c) ASSISTANT, Grade B, for Mechanical Engineering (to H.N.C. with some Electrical to O.N.C.).

The appointments date from 1st September, 1953. Salaries in accordance with Burnham Technical Scales.

Application forms and further particulars (state which post) from the undersigned at 63, Hamilton Square, Birkenhead, to whom applications should be returned by 11th May, 1953.

H. GLYN WILKINSON,
Director of Education.

E8307

BRISTOL EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY

Principal :
F. W. PARTINGTON, M.Sc., A.M.I.Mech.E.

LECTURER

Applications invited for two posts of LECTURER in Engineering Department as from 1st September, 1953 :

(1) To take responsibility for teaching of mathematics. Keen appreciation of application of mathematics to engineering problems essential.

(2) To undertake teaching of engineering subjects at advanced levels.

Both posts at Lecturer's Grade of Burnham Technical Scale. Salary £940 by £25 to £1040. Application forms (to be returned within two weeks) and further particulars by sending stamped, addressed envelope to Registrar, College of Technology, Bristol, 1.

G. H. SYLVESTER,
Chief Education Officer.

E8344

GOLD COAST LOCAL CIVIL SERVICE

GOLD COAST GOVERNMENT

CHIEF ENGINEER GOLD COAST RAILWAY

Appointment is on contract with consolidated salary of £2375 per annum and a gratuity of £37 10s. for each completed three-month period of satisfactory service. Quarters cost £120 per annum. Candidates must possess either a Degree in Engineering or be Corporate Members of the Institution of Civil Engineers, preferably with harbour as well as railway working experience of at least ten years. Duties are preparation of estimates, control of expenditure and responsibility for all works in the Civil Engineering Branch.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number CDE.110/13/03.

E8330

CIVIL SERVICE COMMISSION

SENIOR SCIENTIFIC OFFICERS, SCIENTIFIC OFFICERS, PATENT EXAMINER AND PATENT OFFICER CLASSES

The Civil Service Commissioners invite applications for permanent and pensionable APPOINTMENTS to be filled by competitive interview during 1953. Interviews will continue throughout the year, but a closing date for the receipt of applications earlier than December, 1953, may eventually be announced. The Scientific Posts are in various Government Departments and cover a wide range of scientific research and development in most of the major fields of fundamental and applied science ; in Biology the number of vacancies is small. The Patent Posts are in the Patent Office (Board of Trade), Admiralty and Ministry of Supply.

Candidates must have obtained a University Degree with First or Second-Class Honours in an appropriate scientific subject (including engineering) or in Mathematics, or an equivalent qualification ; or, for Scientific Posts, possess high professional attainments. Candidates for Senior Scientific Officer Posts must, in addition, have had at least three years' post-graduate or other approved experience. Candidates for Scientific Officer and Patent Posts taking their Degrees in 1953 may be admitted to compete before the result of their Degree Examination is known.

Age limits : Senior Scientific Officers, between 26 and 31 ; for Scientific Officers and Patent Classes, between 21 and 28 during 1953 (up to 31 for permanent members of the Experimental Officer Class competing as Scientific Officers). London salary scales : Senior Scientific Officers, (men) £812–£1022 ; (women) £681–£917 ; Scientific Officers, (men) £440–£707 ; (women) £440–£576 ; Patent Examiner and Patent Officer Classes, (men) £440–£655 ; (women) £440–£576. Somewhat lower rates in the Provinces.

Further particulars from the Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S.53/53 for Senior Scientific Officers and S.52/53, S.128/53, for the other posts.

E8298

NATIONAL COAL BOARD

CENTRAL RESEARCH ESTABLISHMENT

SCIENTIFIC TECHNICAL OFFICERS

National Coal Board invite applications for superannuable appointments as SCIENTIFIC TECHNICAL OFFICERS for Metallurgical and Chemical Research at the Central Research Establishment, Isleworth, Middlesex. Metallurgical laboratory experience and qualifications ranging from Intermediate to A.I.M. or equivalent standards are desirable. For one of the posts at least a sound knowledge of general chemical (including coal) analysis and of metallurgical analysis is required, and for other posts a good knowledge of such matters as metallography, heat treatment and testing.

Appointments, according to qualifications and experience, will be as Scientific Technical Officers, Grade I (salary £730 by £25 to £880 per annum, male ; £595 by £20 to £655 by £25 to £730 per annum, female) ; Grade II (salary £485 by £20 to £705 per annum, male ; £390 by £16 to £566 per annum, female) ; or Grade III (£375 by £20 to £535 per annum, male ; £300 by £16 to £428 per annum, female), plus London location allowance.

Write, giving full particulars (in chronological order) of age, education, qualifications and experience (with dates), to National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, marking envelope TT/623. Closing date 18th May, 1953. Original testimonials should not be forwarded.

E8303

THE BRITISH STEEL CASTINGS RESEARCH ASSOCIATION

SHEFFIELD LABORATORIES

METALLURGIST

The British Steel Castings Research Association invites application for the following staff vacancy in its Sheffield Laboratories :—

METALLURGIST of Graduate or equivalent standing required in connection with the Association's programme of work relating to the establishment of basic data on the physical and mechanical properties of steel in cast form. Preference will be given to applicants having interest and experience in the application and testing of engineering materials, steel foundry experience not being regarded as essential.

Successful applicant will be expected to work with the minimum of supervision, and must be accustomed to report writing and to the presentation of experimental data. The appointment carries the status of Scientific Officer, is permanent and superannuable. The salary envisaged is within the approximate range £600–£900, dependent on qualifications.

Applications, which will be treated in confidence, should be in writing to The Director, British Steel Castings Research Association, Broomgrove Lodge, Sheffield, 10.

E1534

RAUCEBY HOSPITAL

SLEAFORD

ASSISTANT ENGINEER

Applications are invited for this post from persons who have completed practical training in mechanical engineering and hold approved qualifications. Salary scale, £425 by £15 by £20 to £525. Unfurnished house available. National Health Service superannuation regulations and conditions of service apply. Applications, giving full details of qualifications and experience, with two names and addresses for reference, must be received by the Group Secretary, Lincoln No. 3 Hospital Management Committee, Harmston Hall, Lincoln, within ten days of this notice.

E8369

CITY OF LEEDS

WATERWORKS DEPARTMENT

APPOINTMENT OF TECHNICAL ST

Applications are invited for the undermen appointments :—

(a) CHEMIST and BACTERIOLOGIST, A.P.T. IX, £815–£935.

(b) ENGINEERING ASSISTANT, Grade VIII, £760–£835.

(c) ENGINEERING ASSISTANT, Grade V., £595–£645.

Applicants for post (a) must have a Degree and/or other professional qualifications must have had experience in the bacteriologi well as the chemical, examination of water.

Applicants for post (b) must be Corporate bers of the Institution of Civil Engineers and have had experience in the design and construc large dams.

Applicants for post (c) must have passed A and B of the Corporate Membership Exami of the Institution of Civil Engineers or hold versity Degree exempting them therefrom and have general engineering experience, preferably a water engineer.

The grading of the posts and conditions of are in accordance with the A.P.T. Division National Scheme of Conditions of Service.

The appointments are subject to the provisi the Local Government Superannuation Act, 19

Selected candidates will be required to pas Corporation's medical examination.

The persons appointed will be required to d the whole of their time to the business of the Cor tion, and will not be allowed to engage either dir or indirectly in private work of any kind.

Appointments will be subject to one mon notice on either side.

Applications, on forms to be obtained from undersigned, should be delivered not later than noon on Wednesday, the 6th May, 1953, end with the description of the post applied for.

Canvassing in any form either directly or indi will be a disqualification.

KENNETH L. FORSTER, M.I.C.E.,
General Manager and Engine
Waterworks Department,
Civic Hall, Leeds, 1,
13th April, 1953.

E82

HER MAJESTY'S COLONIAL SERVICE

PUBLIC WORKS DEPARTMENT, NORTHERN RHODESIA

EXECUTIVE ENGINEER (MATERIAL

Applications are invited for the following pos EXECUTIVE ENGINEER (MATERIA Public Works Department, Northern Rhodesia.

Appointment is on contract/gratuity terms. Sa in the incremental scale £830–£1410 per annum, temporary variable cost-of-living allowance at of 24 per cent of basic salary (maximum £316 per annum). Substantial gratuity payable on factory completion of contract.

Candidates must hold recognised University D or Diploma in Civil Engineering, which m exemption from Sections I and II of the A.M.I examinations, or be A.M.I.C.E. In addition, from having had several years' experience, and should have been engaged in a responsible pos in a laboratory dealing with the testing of mate including soils, concrete, bitumen, and must familiar with the interpretation of test results soils, and design of road and aerodrome pavem Duties will include taking charge of the Mat Laboratory at Lusaka, widening its scope to inc all materials testing for road, aerodrome, bui and general engineering construction, and to org field control of materials used on construction w

Full details available on application.

Apply in writing to the Director of Recruit Colonial Office, Great Smith Street, London, S. giving briefly age, qualifications and experi Mention the reference number CDE.112/3/03.

E82

AIR MINISTRY

WORKS TECHNICAL OFFICER (UNESTABLISHED)

WORKS TECHNICAL OFFICER (Unestablished) required by Air Ministry at Keith, Banffs experienced in (i) handling of 33kV. switchgear split-phase transformers, mercury arc rect Knowles type electrolytic cells and electrically dr compressors ; (ii) operation and maintenance high and low-pressure gas distribution syst Engineer with knowledge of some items plus experience in electrical matters considered. Sa range £896–£1055.—Write, giving date of b education, full details of qualifications and experi of posts held (including dates), to Appointm Officer, Ministry of Labour and National Serv 1–6, Tavistock Square, W.C.1, quoting E.A.39 8th May, 1953. In no circumstances should ori testimonials be forwarded. Only candidates sele for interview will be advised.

E82

MINISTRY OF SUPPLY

ENGINEER

Ministry of Supply require ENGINEER, Lond to plan production and progress contracts for air type radio plugs and sockets, &c. Qualificati recognised eng. apprenticeship and A.F.R.Ae.S. A.M.I.E.E. or Mech.E., or exempting qualificati experienced mass production small compone knowledge aircraft wiring advantageous. Sa £628 (at age 25)–£970, Appointment temporary, opportunities to compete for establishment may —Application forms from M.L.N.S., Technical Scientific Register (K), 26, King Street, Lon S.W.1, quoting D.346/52A. Closing date 15th M 1953.

E82

THE ENGINEER

APRIL 24, 1953

Launch of Royal Yacht

THURSDAY, April 16th, was a Royal occasion at the Clydebank shipyard of John Brown and Co., Ltd., when Her Majesty the Queen launched the new royal yacht and gave the ship the name of "Britannia." This dual purpose ship takes the place of the old "Victoria and Albert," which was built in 1899 and has been long overdue for replacement. The "Britannia" has been built to Admiralty design, but her construction follows merchant ship practice and conforms to the rules of Lloyd's Register of Shipping. The ship has an overall length of 413ft and a water line length of 380ft by 55ft beam and 32ft 6in moulded depth, and when completed will have the hull painted royal blue with white upperworks, buff funnel and masts and will carry the royal coat of arms on her bow. She has a raked bow, modified cruiser stern and three masts; the royal standard will be worn at the main, the Lord High Admiral's flag at the fore and the mizzen will carry the Union Flag. At the after end of the ship abaft the main mast are the royal and state apartments on the shelter and upper decks, respectively, and the accommodation for the officers and crew is forward. Two sets of single reduction geared turbines supplied with steam from two boilers are expected to give the yacht, which will have a load displacement of about 4000 tons, a cruising speed of 21 knots. Among the auxiliary equipment is included a distilling plant, to render the ship independent of shore supplies, and a water purification plant, while to control rolling stabilising gear is to be fitted. The detail arrangements of ship are such that it will be possible to effect conversion to a hospital ship with the minimum of structural alteration, the royal and state apartments becoming wards and operating theatres, for which air conditioning is being installed. As part of the hospital arrangements the after end of the shelter deck is being prepared as a landing space for helicopters carrying patients.

Diesel Engine Users' Association Annual Luncheon

THE annual luncheon of the Diesel Engine Users' Association was held on Thursday of last week at the Connaught Rooms, Great Queen Street, London. Immediately following the loyal toast the president, Mr. Gerald B. Fox, presented the Percy Still Medal to Mr. C. H. Bradbury for his paper, "Torsional Vibration in Diesel Engines—Some Observations and Practical Aspects." In proposing the toast of "Our Guests," the president had something to say about the harmony existing between the scientist and engineer to-day compared with the position of years ago, and he also introduced the subject of the over-rating of diesels. Mr. W. R. Cook, C.B., the Chief of the Royal Naval Scientific Service, who was the principal guest, gave the toast of "The Association," and recalled that it was the impact of modern science on warfare that caused the Admiralty to set up the Royal Naval Scientific Service in 1946. Mr. Cook remarked that the naval officer and the scientist have much to contribute, and that the integration of the user and the research and development staff within one ministry was of considerable advantage in arriving at speedy decisions. Continuing, Mr. Cook mentioned the need for a reduction in diesel engine noise and that an investigation into the sources of noise was imperative. He was sure that supercharger noise could be reduced and that the production of a quieter displacement blower was possible. The advent of the Snort in submarines pointed to the need for more economic use of air and Mr. Cook felt that ways should be found to utilise exhaust heat more fully, such as giving it to the inlet air without reducing scavenging efficiency. Another problem under review was the question of heat loading, and the possibilities of oil in water emulsions was being studied, together with an investigation into the question of heat transfer between moving surfaces. Mr. Cook went on to say that his department was actively engaged in research in many other directions, including the problem of rotor design involving the methods of calculation of thermal stresses, work on the design of combustion chambers linked with the determination of questions relating to the radiation of fuels and tests to establish the reliability of ball and roller bearings.

British Steel Founders' Association Convention

A THREE-DAY convention organised by the British Steel Founders' Association and held in London last week from April 15th to April 17th, was well attended by designers, manufacturers and users of steel castings. The convention and an exhibition which formed an integral part of the proceedings were opened by the Minister of Works, Mr. David Eccles. It was organised with a view to giving those concerned with the manufacture of steel castings and their users an opportunity to hear and discuss one another's problems, and to formulate plans to ensure a greater degree of co-operation for their mutual benefit in the future. In the course of the convention five papers were presented: "Steel Castings and Their Application," by Mr. F. Rowe; "Customer Experience with Steel Castings," by Mr. A. C. Annis and Mr. R. A. Riddles; "Quality Control and Inspection as a Part of the Manufacturing Process," by Dr. J. Rait; "Research as it Affects the Customer," by Mr. J. F. B. Jackson, and "Policy Making and Fact Finding," by Mr. T. H. Summerson. After each paper was read a discussion was held in the course of which questions were put to the authors and delegates were able to put forward their particular views on the subject. The exhibition was arranged in two sections, one devoted to the metallurgy of steel castings and their design, and the other showing representative examples of the wide variety of uses to which steel castings are put by industry. As the actual exhibits were necessarily restricted in size, the exhibition halls were used to display photographs and models of typical large steel castings made in this country. To mark the occasion of this first "customer-founder" convention, the Association has published a book dealing with the origin and aims of the Association, and giving a list of its member firms.

The Utilisation of Low Grade Ores

THE Department of Scientific and Industrial Research has announced that a mission from the Organisation for European Economic Co-operation is visiting this country this week to gather facts on research into the exploitation of low-grade ores. The party is spending five days in visiting laboratories and mines and holding informal consultations with British experts. The mission proposes also to visit France, Germany, Italy and Sweden. The D.S.I.R. says it is hoped that, as a result of the mission, closer co-operation between organisations interested in mineral dressing will come about and that methods will be developed of mining and dressing low-grade ores which have as yet been uneconomic to mine. The mission includes experts from Austria, Belgium, France, Germany, Greece, Italy, Norway, Sweden, Turkey and the U.S.A. The British representatives are Professor J. A. S. Ritson and Dr. W. Davies, head of the Ore Dressing Laboratory of the United Steel Companies, Ltd. Among the establishments which the mission is visiting are the Mineral Dressing Laboratories at Harwell, the Research Laboratories of the General Electric Company, Ltd., the Bessemer Laboratories of the Royal School of Mines and mines at Plymouth, St. Austell and Pendeen.

British Electricity Sales

ACCORDING to provisional figures published by the British Electricity Authority the number of units of electricity sold by the Authority in March, 1953, was 5460 million kWh, compared with 5042 in the corresponding month last year. Allowing for weather conditions and the number of working days the percentage increase was 7·3 per cent. The corresponding comparisons for the first two months of the year show that the sales were up by 6·0 per cent in January, 1953, and by 5·9 per cent in February, 1953. These figures suggest a change in the downward trend that characterised most of 1952, reaching a trough in August, when the sales were actually 0·7 per cent less than in August, 1951. The provisional statistics for the sales of electricity by the individual Area Boards in March, 1953, compared with March, 1952, show that for the most part the increases were recorded by Area Boards in which non-industrial loads predominated; however, the largest increase, 13 per cent, was made in the East Midlands, which is mainly industrial. Other significant increases were: South-Western, 12·1 per cent; London, 11·2 per cent; Southern, 10·3 per cent; South-Eastern, 9·5 per cent; Eastern, 9·9 per cent; South Wales, 8·8 per cent; Yorkshire, 8·1 per cent, and, at the other end of the scale, Merseyside and North Wales, 0·3 per cent. The mainly industrial areas showed an increase of 6·8 per cent, and the mainly non-industrial areas an increase of 10·3 per cent.

Southern Branch of the I.N.A. and I.Mar.E.

THE Southern Junior Branch of the Institution of Naval Architects and the Institute of Marine Engineers has now been dissolved and has been replaced by a Southern Joint Branch which takes in all grades of membership of the two societies. At the inaugural general meeting of this new branch, which was held recently at Southampton, Mr. R. W. L. Gawn was elected president, Mr. T. W. Paradise, honorary secretary, and Mr. W. J. Ayers, honorary treasurer. In the course of his presidential address, which followed the election of officers, Mr. Gawn surveyed the development and the work of the Institution of Naval Architects and the Institute of Marine Engineers, and described the steps which had led to the formation of the Southern joint branch. He said that shipbuilding was one of the oldest arts of man, and he felt that it could be claimed that the south had always been prominent in furthering the advance of that art. It was true, Mr. Gawn continued, that in recent years large ships had been built in yards remote from the south, but shipbuilding and marine engineering continued with keen energy in the region, and ship model research, which had revolutionised naval architecture, although born in the west, soon migrated to the south, where it had flourished. Mr. Gawn went on to say that it was not surprising that the Institution of Naval Architects and the Institute of Marine Engineers had jointly no less than 600 southern members. But, he added, members alone did not ensure quality or efficiency. The strength of the branch would be found in the zeal and energy which its members displayed in furthering the objects of the two societies by promoting the improvement of ships and all that appertained to them, and by providing an organisation to further those interests. Naval architects and marine engineers, Mr. Gawn emphasised, were professional partners whose combined skill found expression in the creation and operation of that great work of man, the ship.

British Industries Fair

No. I

ON Monday next the British Industries Fair opens at Earls Court and Olympia in London and at Castle Bromwich. It will be open daily except Sundays until Friday, May 8th. As in previous years the main centre of attraction for engineers will be at Castle Bromwich, where some 450 firms in the engineering and allied trades will be showing representative examples of their products.

From preliminary information which we have received from exhibitors it would seem that but little plant or equipment of outstanding new design will be shown. There will, of course, be a certain amount of plant incorporating improvements and modifications, and new models which have been added to extend the range of existing machines. This article deals with some of the exhibits at Castle Bromwich. Descriptions are given of some of the new equipments to be shown and those which incorporate new points in design, as well as some which, although not new, will be displayed for the first time.

Scottish Machine Tool Corporation, Ltd.

The equipment to be on the stand of the Scottish Machine Tool Corporation, Ltd., of Glasgow, includes the splitting shears and punch made by James Bennie and Sons, Ltd., and illustrated in Fig. 1. This machine incorporates a bar, angle and tee cropper and is the smallest of three sizes made by the firm, being designed to punch holes up to 1in diameter in ½in plate and shear plates up to ½in thick with its 11in long shear blades.

The main frame of the machine comprises two heavy rolled steel plates fitted with distance pieces and bolted together to form a rigid structure. A 6 h.p. electric motor drives the machine through vee belts and all motions are obtained from a forged steel eccentric shaft.

At the punching end a balanced cast steel slide is operated by a lever and compression link, provision being made for single stroke or continuous operation. At the other end of the machine the bar cropper and plate shear are carried in a rigid cast steel rocking lever which is operated by a compression link from the eccentric shaft. This rocking lever is balanced by a spring, which retains it in the uppermost position when the compression link is disengaged. If required, a notching device can be fitted above the plate shear for cutting rectangular notches in the edges of plates, angles, joists or channels.

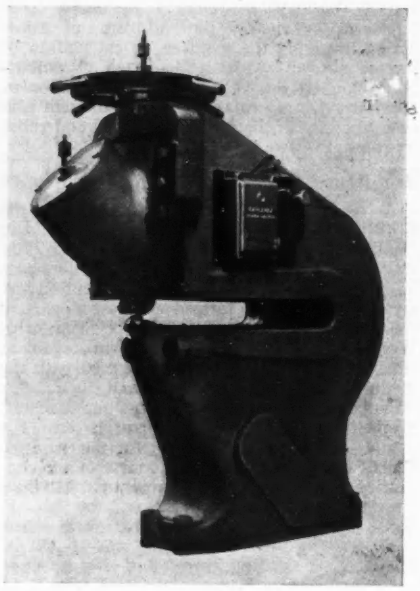


Fig. 3—Rotary Shearing Machine—Scottish Machine Tool Corporation

Two presses made by Craig and Donald, Ltd., are to be exhibited, one of 200 tons and the other of 230 tons capacity, together with the rotary shearing machine shown in Fig. 3. This two-motor drive shearing machine is designed to handle mild steel plates up to ¾in thick and has a gap 36in deep. Its top and bottom cutter spindles are driven through gearing by individual motors having their speeds synchronised. Each motor has two speeds, one giving a cutting spindle speed of 4ft and the other of 8ft per minute.

S. Denison and Son, Ltd.

A piece of equipment to be seen amongst the interesting group of testing machines shown upon the stand of Samuel Denison and Son, Ltd., Hunslet Foundry, Leeds, 10, will be a new compression and transverse testing machine, which has been specifically designed to fulfil the requirements of the concrete and highway engineering trades in complying with British Standard Specifications.

This testing machine—see Fig. 2—has a maximum capacity of 10,000 lb and is completely self-contained, requiring no special foundations. It is designed on the weighing lever principle, and the load on the specimen is applied by means of a handwheel and non-rotating straining screw on the front of the machine. The steelyard indicator mechanism, is fitted with a motorised poise weight so that uniform loading can be applied, as required by British Standards. The operator turns the handwheel on the front

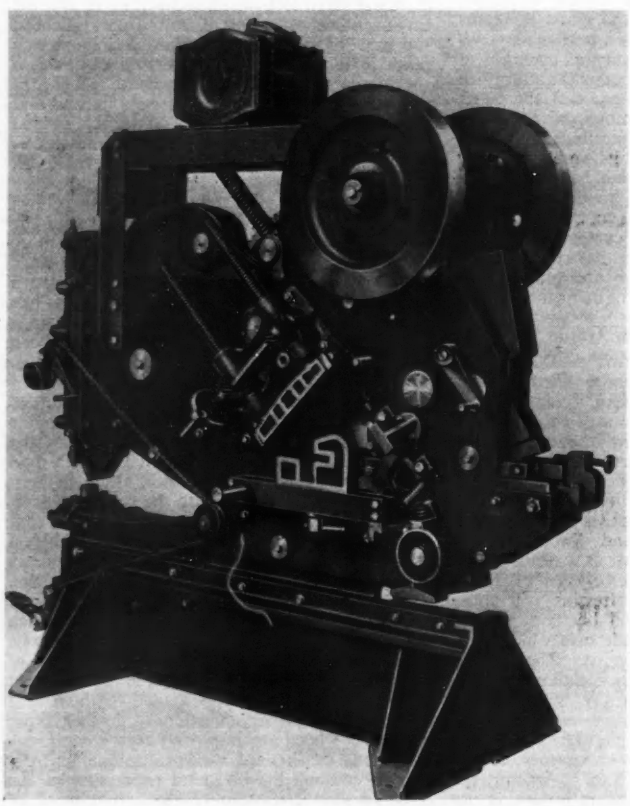


Fig. 1—Splitting Shears and Punch—Scottish Machine Tool Corporation

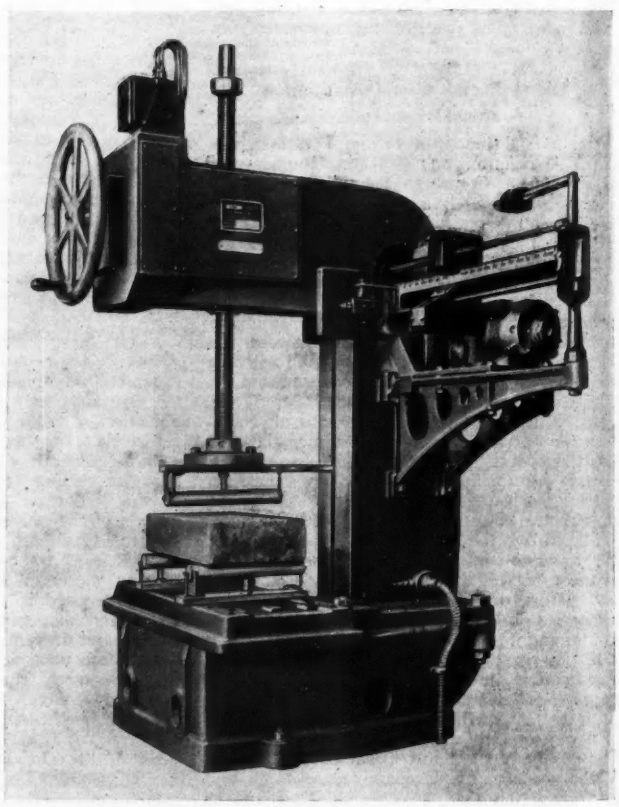


Fig. 2—Compression and Transverse Testing Machine—Denison

of the machine at such a speed as to maintain the steelyard in a floating position.

An adjustable tare bar is incorporated for the purpose of balancing off the weight of the tackle and the specimen before testing. There is also an automatic knock-off switch for stopping the motor when the specimen fractures.

The main column carrying the straining gear and the load indicating mechanism is of overhung design, arranged to give easy access to the specimen table. All controls are on the front of the machine so that the operator can easily ke[illegible] both the indicating mechanism and the speci[illegible] under observation.

John Thompson, [illegible]TD.

The exhibits of John Thompson, Ltd., Wolverhampton, and its associated [illegible]mpanies will include a chain grate stoker for shell type boilers introduced by John Thompson (Wolverhampton), Ltd., some two years ago. This stoker, a working model of which is to be shown, is stated to be adaptable for burning 100 per cent coke breeze with a minimum of draught duct modification. A composite section of the stoker unit is the submerged belt ash disposal system of the John Thompson Conveyor Company. This ash disposal unit consists essentially of "U"-shaped trough with guide wheels at each end and cast iron formers giving the rubber and fabric reinforced endless belt a profile similar to that of the trough.

Chutes from the hoppers collect ashes as they are discharged over the stoker dumping noses and feed them into the trough below, where the water immediately quenches them as they settle on the belt. This belt usually travels at approximately 12ft per minute but through a variable speed drive the travelling speed of the belt can be varied between 6ft to 24ft per minute, depending on the rate of discharge from the ash chutes.

An oil-fired La Mont boiler, which will be on the stand, is designed for a continuous maximum rating of 3600 lb per hour, although with its auxiliaries its overall dimensions are only 9ft by 9ft by 9ft. Other exhibits include a de-superheater, a working model of a rotary pickling plant, water treatment equipment, &c.

Bronx Engineering Company, Ltd.

A three-roll pyramid bending machine for mild steel plates up to 10ft wide and ½in thick, and a 60-ton press brake will be exhibited by the Bronx Engineering Company, Ltd., of Dudley Road, Lye, Worcs.

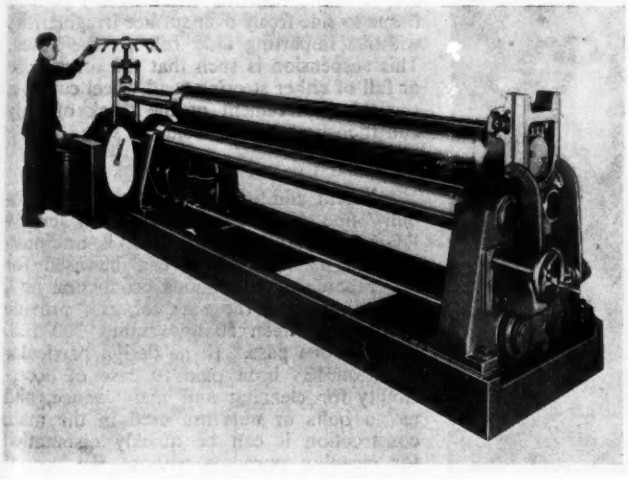


Fig. 4—Plate Bending Machine—Bronx

The bending machine, Fig. 4, has a fabricated steel bedplate, with a substantial cast iron bedplate at the driving end which carries the gear drives, motors and controls. Heavy box-section cast iron housings are rigidly bolted to the bedplate. In these housings the bottom rolls are carried in phosphor-bronze lined bearings, and enclosed in the lower part of the housings is the worm gearing used for adjusting the top roll. This top roll is mounted in phosphor-bronze lined cast steel bearings pivoted to the upper ends of the adjusting screws in such a way that the end bearing can be swung clear for removing a cylinder or to permit the tilting of the roll for conical rolling. The top roll has a diameter of 12in and the bottom rolls are 10in in diameter. Grooves are cut in the periphery of the bottom rolls to assist in gripping the plate.

The rolls are driven by a 16 h.p. motor through a flexible coupling and a gearbox incorporating a hand-operated reversing gear. An 8 h.p. reversing motor is used to drive the worm gearing used for top roll adjustment. In this roll adjustment drive, in order to permit tilting of the top roll, a separate clutch is fitted in the main driving shaft connecting the two housings. This clutch is used to disengage the worm gearing at the extreme end when it is required to tilt the top roll. An indicator is fitted at the operator's position to show the exact position of both ends of the top roll at all times. Electric limit switches are fitted to cut out the driving motor should the top roll be accidently overrun either up or down. An extension provided on the top roll counterbalances the weight when swinging down the end bearing. This support engages the ball end of the roll and is operated with a handwheel through spiral gears and screws.

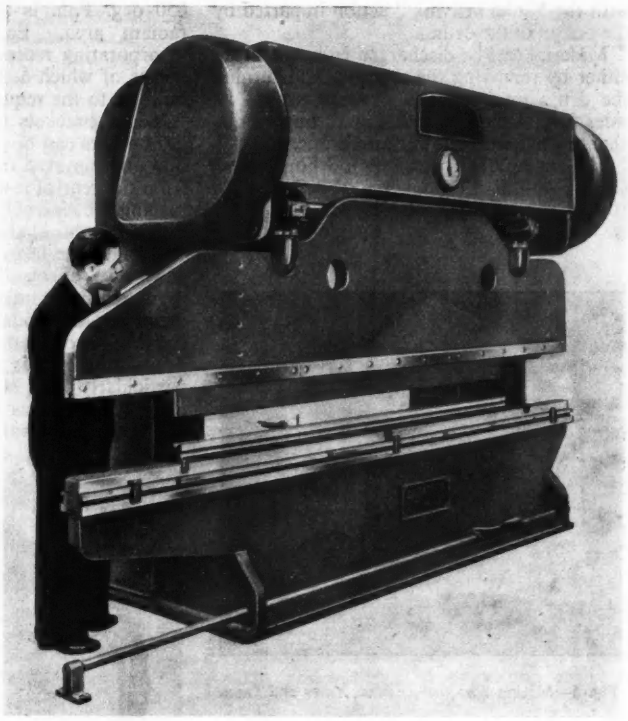


Fig. 5—60-Ton Press Brake—Bronx

The 60-ton press brake shown in Fig. 5 is designed to bend mild steel 8ft long by ¼in thick or 6ft long by $\frac{5}{16}$in thick between the columns or 10ft long by 12 gauge over the full beam length. It has a 3in stroke and the die space with the stroke down and the adjustment up is 11in, the top beam adjustment being 4in.

In the welded steel plate frame the bottom beam rests on machined abutments on the two side columns and is welded in position to form with the heavy top crown a rigid box structure.

The top beam is adjusted by a separate 1 h.p. squirrel-cage flange-mounted motor driving through a reduction gearbox a worm and large worm-wheel nut in each connecting rod. A dog clutch is provided so that the top beam can be positioned parallel to the bottom beam and limit switches are fitted to prevent overrun of the beam.

The connecting rods are of cast iron and are fitted with large phosphor-bronze bush bearings for the eccentric shaft throws. Spherical-ended ball screws working in large phosphor-bronze worm-wheel nuts are used for raising and lowering the top beam adjustment. These ball screws are located by high-tensile square-ended pins to cast steel pressure cups which are fitted for a full bearing seating. The forged carbon steel eccentric shaft is machined and ground all over except on the sides of the throws.

The flywheel of the machine is driven through vee belts from a 5 h.p. motor. A multi-plate friction clutch bolted to a register on the flywheel operates in conjunction with a brake and gives complete control for inching purposes.

Foster, Yates and Thom, Ltd.

Together with the automatic moulding press, which was shown last year and described in our issue of May 23rd, 1952 Foster, Yates and Thom, Ltd., of Blackburn, will be exhibiting models of its "Rotocube" dry powder mixing machines. Several sizes of these mixing machines are made for laboratory and industrial purposes in capacities ranging from 10 lb to 1600 lb.

As can be seen from the illustration Fig. 6 of a typical industrial machine, the mixers have a cube-shaped drum mounted diagonally at an angle on trunnions. The drum is rotated at about 10 r.p.m. and its design is such that heavier ingredients cannot accumulate at the bottom of the mix, and each constituent is uniformly distributed in a relatively short mixing period. If necessary, impellers can be incorporated, and they are rotated in the same direction as the drum to combine a gentle "overturning" motion

with the " interweaving " action imparted by the design of the drum.

Material can be discharged from the drum either by removing the main lid and turning the drum into a position where two of its sides form a natural chute, or through a discharge valve in the lowermost corner.

The machine is driven by a low horsepower electric motor through vee ropes and an 80 : 1 reduction gear, to which the drum is attached by half couplings. The

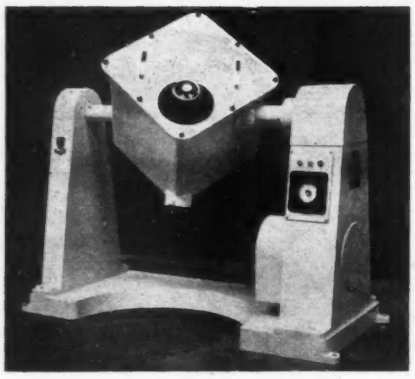


Fig. 6—Mixing Machine—Foster, Yates and Thom

impeller shaft driving gears are housed at the opposite end of the machine and consist of a driving spur fixed to the end of the drum trunnion, an intermediate compound gear, and a driving spur on the impeller shaft. This train produces a speed ratio between the impeller shaft and the drum of approximately 3 : 1. A push-button starter switch gives stop, start and inching control, and a process timer, graduated in minute intervals from 0 to 80 minutes can be incorporated, if required.

Parkinson and Cowan (Gas Meters), Ltd.

Some typical tunnel arrangements of the gas-heated radiant panel units, which will be seen upon the stand of Parkinson and Cowan (Gas Meters), Ltd., Cottage Lane, City Road, London, E.C.1, are illustrated in Fig. 7.

The panel units used to build up these tunnels are 36in wide, 19in high and 6in deep, and each has a radiant area of 4·5 square feet. They can be used in a vertical position or inclined up to 45 deg. in either direction, and an even temperature up to a maximum of 650 deg. Fah. is available over the whole radiant area. Each unit has cast ends incorporating recesses with tapped holes by means of which assemblies of panels can be built up to the required form with the aid of standard brackets and floor supports. The gas burners can be inspected whilst in operation and removed for cleaning or adjustment from the rear of a unit without need for disturbing the assembly. The products of combustion are discharged from the top of each panel into the heated zone and add a useful convection effect.

A recently introduced laboratory gas meter of new design (Fig. 8) to be shown by the firm incorporates an original measuring drum, which, it is stated, makes possible a particularly high standard of accuracy and efficiency. In this drum the compartments are formed by partitions of helical shape,

Fig. 8—Laboratory Gas Meter—Parkinson and Cowan

a design which gives no variation of cross-sectional area of the compartments. The partitions are so arranged that they are always perpendicular to the surface of the water, when entering or leaving it, so that any " paddle " action is eliminated, and the helical drum can run at 1000 revolutions per hour. The casing in which the drum is housed is of tinned brass with a cast hiduminium front plate, secured by twelve socket head screws and sealed by an oil-resisting gasket. This design ensures that all components of the meter which govern its accuracy are mounted to a common datum.

The front plate carries the drum, bearings, thermometer, water line box, spirit level, &c.; thus, when the meter case is removed from the front plate every part of the meter is immediately accessible. The meter has a capacity per revolution of $^1/_{50}$ cubic foot, or $\frac{1}{2}$ litre, and its maximum hourly capacity is 20 cubic feet, or 500 litres.

I.T.D., Ltd.

The materials-handling equipment to be demonstrated on the stand of I.T.D., Ltd., 95–99, Ladbroke Grove, London, W.11, will include a heavy duty battery-electric fork lift truck, on view for the first time. This machine is illustrated in operation in Fig. 9. With a lift height of 9ft it handles up to 4500 lb at 20in centres or 4000 lb at 24in centres.

The truck has a rigid frame at the forward end of which is the solidly mounted drive axle carrying the lifting mast and forks. At the rear end is a cast balance and guard block, designed to act as a fender for the full height of the truck body. The deck of the chassis carries, towards the rear, the battery, which is housed in two sections for easy removal by crane lift.

At the forward end of the chassis are the hydraulic oil tank, the driving seat, hydraulic control levers and operating pedals. The driving footplate can be removed to allow inspection of the electrical control and hydraulic mechanisms below. At each side

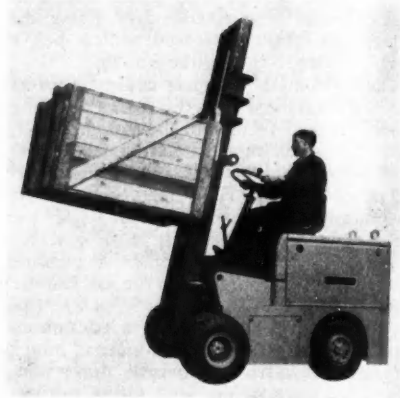


Fig. 9—Heavy-Duty Fork Lift Truck—I.T.D.

of the main frame a pannier compartment is formed to accommodate, on the right-hand side, the hydraulic pump and motor assembly, and, on the left-hand side, the electrical driving control unit. Both of these assemblies hinge outwards to provide full accessibility.

Four road wheels give an effective sideways stability consistent with a semi-sprung suspension. The steering axle is fitted with semi-elliptic springs carried on an axially pivoted frame to ride freely over surface irregularities without imparting side roll to the truck. This suspension is such that the forced rise or fall of either steering road wheel causes a vertical displacement of the truck of only half the wheel displacement.

British Jeffrey-Diamond, Ltd.

A recent addition to the range of " Atomill " fine grinders made by British Jeffrey-Diamond, Ltd., of Wakefield, is an intermediate machine which can be used for either batch or continuous production and, depending upon the material, can provide products between 50 and minus 300 B.S. mesh in one pass. In its design particular attention has been paid to ease of accessibility for cleaning and maintenance, and as no bolts or nuts are used in the main construction it can be quickly dismantled for cleaning purposes without the use of spanners.

The general arrangement of the new

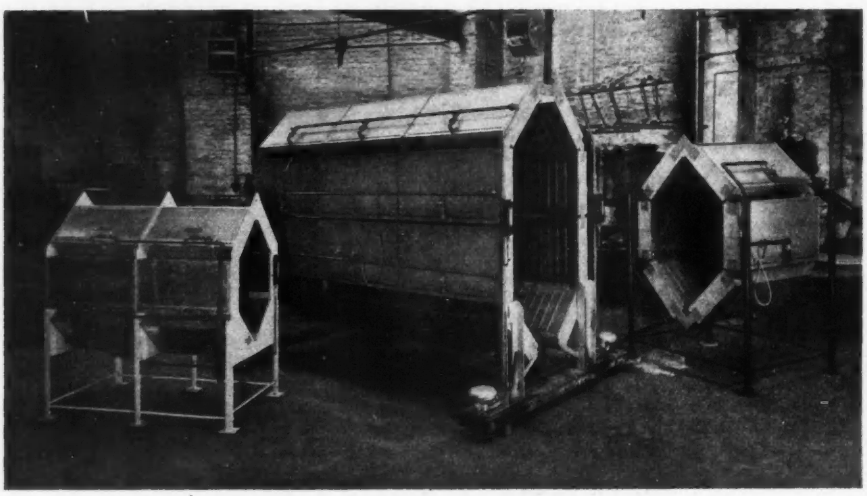


Fig. 7—Radiant Heating Units—Parkinson and Cowan

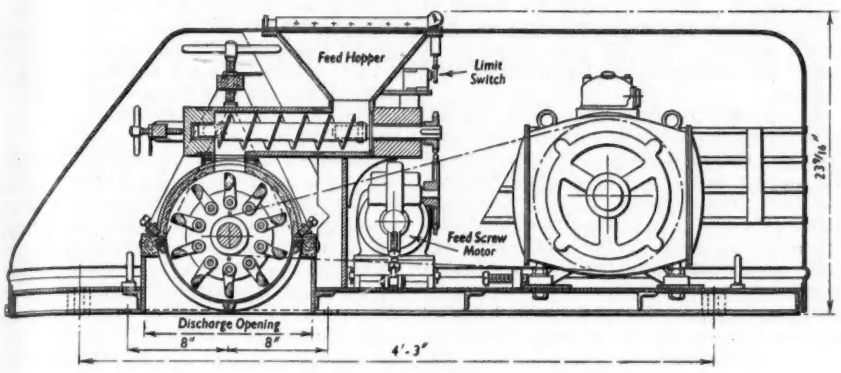


Fig. 10—Fine Grinding Machine—British Jeffrey-Diamond

machine can be seen in the drawing, Fig. 10. It consists of a grinding chamber which encloses a balanced rotor driven by vee ropes from a 10 h.p. motor at 6000 r.p.m. To this rotor are attached ten hammers fitted with tipped wearing faces, which serve to drive the material against a serrated grinding liner of heat-treated steel. Material is fed into the grinding chamber from the overhead feed hopper by a screw driven by a fractional horsepower motor. The motors and starters are connected in such a way that the feed screw motor cannot be started until the main motor has attained its running speed.

Provision is made at the base of the grinding chamber for the fitting of perforated screens which are supplied in varying degrees of fineness. The material is reduced to the desired size and discharged through the screens, oversize being swept round by the hammers for further reduction on the grinding plates. The screens play little part in the grinding operation but act principally as particle retainers.

H.E.C. Compressors and Engines, Ltd.

All of the air compressors made by H.E.C. Compressors and Engines, Ltd., of Stechford, Birmingham, 9, are single-stage, air-cooled units operating generally at a maximum pressure of 150 lb per square inch. Both stationary and portable machines are made with displacements ranging from 2 to 16 cubic feet per minute. The exhibits at Castle Bromwich will be fitted with automatic starters and most of them are available with either motor or petrol engine drive.

Typical of this firm's products is a new 2½ cubic feet displacement unit, illustrated in Fig. 11. A 12in diameter by 24in long air receiver fitted with wheels can be used for mounting either an electric motor or petrol engine-driven compressor. If required the compressor unit, which is independent and mounted in its own tubular carrier, can be removed from the air receiver and used in any required place. The compressor has a bore of 2in with a stroke of 1in. In the unit to be seen on the left in our illustration the compressor is driven by a ½ h.p. motor at 1425 r.p.m. and in the right hand unit it is directly coupled to an 80 c.c. two-stroke petrol engine.

Two other new units which will be shown by this firm are both direct-coupled, petrol engine-driven compressors mounted on wheeled trolleys, one being a single-cylinder, 2½ cubic feet per minute unit, and the other a twin-cylinder, 5 cubic feet per minute, displacement machine.

Acru Electric Tool Manufacturing Company, Ltd.

A useful small tool now being made by the Acru Electric Tool Manufacturing Company, Ltd., Chapel Street, Levenshulme, Manchester, 19, is an engineer's square with which the angular error between finished plane surfaces can be read directly in 0·001in per foot on a dial gauge in the body. In this tool, which is to be seen in Fig. 12, the blade is pivotally mounted in, and angularly movable relative to, the body. A clamping means is incorporated at the pivot point to enable the frictional resistance to be adjusted.

The blade has attached to it a long finger, which extends down within the body and along the centre line, and this finger engages the feeler element of a dial gauge. A return spring connected to the lever moves the blade to the minus or plus side of a true right-angle and the dial gauge can be adjusted to zero. The proportions of the indicator and lever are such that one division on the dial represents 0·001in error per foot and the dial is calibrated to indicate up to 0·030in error per foot plus and minus.

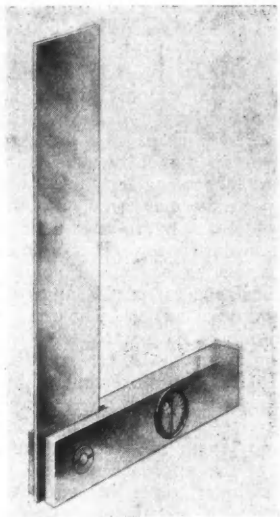


Fig. 12—Indicating Engineer's Square—Acru

If, through rough handling, a slight distortion takes place, the zero point can easily be adjusted by putting the square against a known true 90 deg. angle and the scale then reset to zero and fixed in that position.

Together with this square the firm also supplies a master square consisting of a casting with a precision ground base and having instead of a square blade two tungsten tipped screw heads set to give an exact 90 deg. angle. On this master square one angle has to be ground, the second angle being provided by two set-screws which are fixed by nuts.

Slack and Parr, Ltd.

A new drilling machine has been specially designed and built by Slack and Parr, Ltd., of Kegworth, near Derby, for use with its gearless, fixed-centre drill heads, used for drilling groups of holes up to ¼in diameter in components. As can be seen from the illustration below (Fig. 13), the headstock of the machine carries a flanged spindle housing on which the drill head is accurately located and bolted. The spindle is mounted in ball bearings in the housing and has a tanged end which provides a positive drive to the drill head. A 1 h.p.

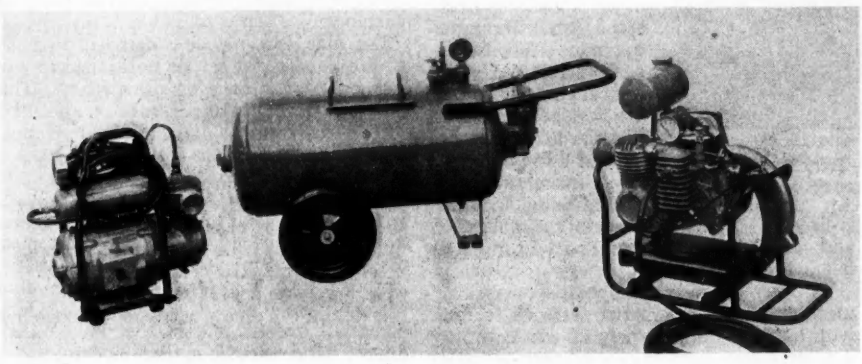


Fig. 11—Air Compressor Units—H.E.C.

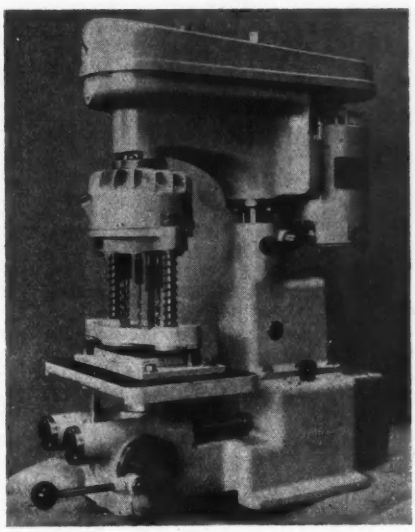


Fig. 13—Drilling Machine—Slack and Parr

motor drives the spindle through vee belts and three spindle speeds of 1090, 1450 and 1930 r.p.m. are available.

The heavy cast iron base of the machine provides a rigid support for the headstock pillar and the height of the headstock can be adjusted by means of a jack screw projecting from the top of the machine. Drilling is effected by feeding the table carrying the work up to the drill head, and within the base is fitted a hydro-pneumatic unit for table feeding purposes. This table operating mechanism gives a semi-automatic drilling cycle consisting of rapid approach, feed stroke and quick return. The cycle is started by operation of the control lever to be seen projecting from the lower right-hand side of the base. This movement admits air to a power cylinder, which gives a rapid initial upwards table approach movement, the speed and length of which is pre-set. At the end of this approach stroke a hydraulic control cylinder comes into effect to restrict the continuing movement during the feed stroke to a pre-set speed. A feed regulator which governs the flow of oil from the hydraulic control cylinder can be adjusted to give any required speed of table feed. The feed stroke of the table continues until travel is halted by a depth limit stop, and then upon release of the table control, the table rapidly returns.

The table has a working surface of 12in by 6in and a movement of 2in, the maximum distance available between the table and spindle housing flange being 16in.

The firm will also be showing a representative selection of its other multi-drill heads and gear type metering pumps for laboratory and similar installations which are made with outputs ranging from 0·3 c.c. to 100 c.c. per revolution and feed pressures up to 1000 lb per square inch.

W. and T. Avery, Ltd.

A new electronic scale designed to supply a constant flow of material in pounds per hour, is to be exhibited and demonstrated by W. and T. Avery, Ltd., of Soho Foundry, Birmingham, 40. With this machine, instead of weighing individual quantities by hand, materials can be fed in through a hopper at one end and the scale ensures that the correct weight flows out at the other. Once it has been set the machine is self-correcting. The constant rate feed scale is designed particularly for the non-stop mixing and blending of granular materials such as chemicals, baking ingredients, powders, &c., which are fed into it by gravity, or by a screw conveyor if the material is not free-flowing.

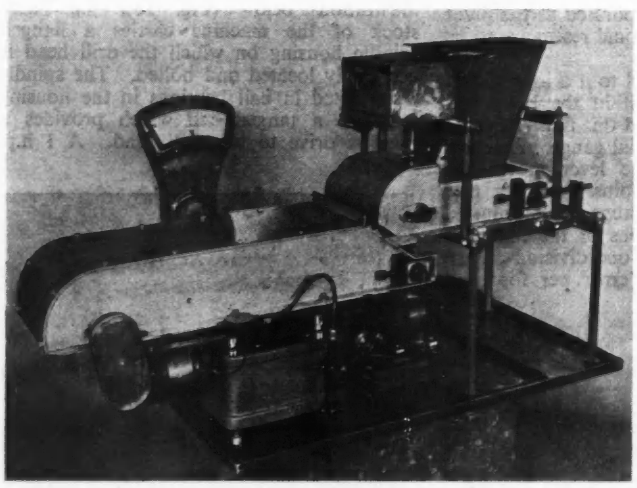


Fig. 14—Constant Weighing Machine—Avery

In the new machine (Fig. 14) a blanket of material is fed on to a moving belt and balanced against a weight box. As long as the correct weight is flowing along the belt the feed stays constant, but if there is an error of as little as three drams, an electronic switch fitted to the scale alters the feed to correct the error. A very wide weighing range, in pounds per hour, can be obtained with the machine, which is set by altering the weights in the weight box and by choice of belt speed.

The machine is to be shown in constant operation, together with representative examples of the firm's many designs of weighing and other plant.

W. Canning and Co., Ltd.

In order to show the developments which have taken place in the design of automatic plating plants, W. Canning and Co., Ltd., of Birmingham, proposes to display two models of typical plants on its stand. One model, originally constructed in 1927, is representative of plants made by the firm and installed between 1924 and 1939. It shows equipment made for dull nickel plating only, together with the preparatory cleaning processes. In such an installation the change-over from one tank to another is made by means of chain-driven swivelling pockets.

The model of the modern equipment shows the latest design of plant incorporating both bright nickel and chrome plating processes, with the various cleaning units. In this plant hydraulic mechanism is used to transfer components from one tank to the next and the carriage is operated as a single unit. Ancillary equipment on the model includes rectifiers, filter units, exhaust ducts, &c., and although the plant is shown with steam heating equipment, it is pointed out that electric heating can be arranged. This design of plant can be supplied for various plating processes and the ducting can be arranged for either overhead or underground extraction.

Amongst the plating barrels to be shown on this stand is an improved "Duomax" two-speed, motor-driven unit suitable for either nickel or cyanide plating solutions. It can be arranged for single-speed operation at 5 r.p.m. or two-speed, 5 and 10 r.p.m., operation. The barrel can be set to run at any angle to suit the articles being plated and the barrel can be rotated during emptying. The angle at which the barrel is inclined is fixed by means of a worm and quadrant and can be altered as required by turning a handwheel.

An eight-spindle automatic polishing machine to be exhibited is designed to deal with a considerable variety of articles up to 4in diameter. It has a central rotating table carrying the eight rotating chucks for holding the articles to be polished, and adjustable polishing heads set at various positions round the table can be set to polish the articles at any required angle. An attachment is provided on the polishing heads to permit fine adjustment of feed and to compensate for mop wear.

A rotary finishing barrel for the bulk deburring, scouring or burnishing of small components in various metals and alloys is also to be shown. This rubber-lined barrel has capacity for about 3 cwt of work and in the process special pebbles or compounds suitable for scouring or burnishing are employed. The barrel is driven through gears and vee belts from a 5 h.p. motor and its speed of rotation can be varied between 13 and 39 r.p.m. in either direction.

Aveling-Barford, Ltd.

A useful new machine which will be seen amongst the representative examples of road rollers and other constructional plant made by Aveling-Barford, Ltd., of Grantham, is the small three-wheeled dumper. This machine is designed for working both on sites under unfavourable ground conditions or in industrial establishments, as shown in Fig. 15. It has a capacity of ½ cubic yard or 12 cwt and is designed to carry a full load at some 3½ miles an hour.

Fig. 15—Three-Wheeled Dumper—Aveling-Barford

The dumper has a rigid plate frame of welded construction reinforced by steel cross members and is arranged for front wheel steering. Its power unit consists of a 4½ b.h.p. J.A.P. air-cooled petrol engine arranged in an easily accessible position behind one side of the driver's seat. The drive is transmitted through a double-acting plate clutch and constant mesh gears driving the differential rear axle through a roller chain. A large diameter horizontal steering wheel operates through machine cut reduction gearing and the driver uses a single lever for starting, stopping or reversing the machine.

The wide, low hopper is designed to make loading easy and it can be positioned to give a level base for carrying piece loads. This hopper, which is balanced, rolls on a toothed rack and requires only a slight manual assistance to empty the load and re-set.

Other dumpers on this stand will have capacities of up to 4½ cubic yards and the firm will show road rollers in weights ranging from 30 cwt to 15 tons, and the largest piece of equipment displayed will be an Aveling-Austen "99-H" grader, which has four wheel drive and four wheel steering. Other plant will include one of the fim's "Calf-dozers" and a trench cutting machine.

(*To be continued*)

The Athlone Fellowship Scheme

No. II—(*Concluded from page 568, April 17th*)

A PAPER "The Athlone Fellowship Scheme for the Practical Training in Industry of Canadian Engineering Graduates in Great Britain," was presented by Dr. W. Abbott at a meeting of the Institutions of Civil, Mechanical and Electrical Engineers, on Friday, April 10th. Further abstracts from the discussion are reproduced herewith.

Mr. R. E. Collin (an Athlone Fellow) said that Dr. Abbott had pointed out in the paper that there seemed to be a tendency for the majority of the Fellows to vote for university training. He thought this was quite a natural thing to expect, because the young Canadian engineer with a high academic standard was rather reluctant to let the possibilities of a fundamental research period slip by. He thought also that to eliminate that Fellow from the scheme would no doubt lower the standard of the award; he imagined that if such a man were eliminated, the competition for the award was bound to drop. However, as had further been pointed out by Dr. Abbott, if too many of the Fellows voted for university training, the Athlone Fellowship Scheme might very well fail in its basic purpose, since it would not acquaint young Canadian engineers with British industry. But it would seem that this would not necessarily need to be so. The university trainee was primarily interested in his college course and in his own little private research partly, but, nevertheless, he still had quite a considerable interest in the practical machines and equipment that were related to his branch of engineering. The British manufacturer should perhaps make a special effort to acquaint the university trainee with the capital goods and equipment that they wished to sell on the Canadian market.

Mr. H. J. B. Harding said that British contractors had been doing what they could to assist in the matter of training visitors. But the contractors had difficulties in finding the necessary positions. For example, in his own firm they had simultaneously two Royal Engineers majors, two oil company engineers, two from the Colonial Office Scheme, and one Australian for whom to find corners. Unfortunately, they had no Athlone Fellows; none had applied. The point about obtaining practical training in civil engineering was that it could be obtained quickest where the man was shouldering personal responsibility. If he was standing watching, he was in danger of becoming only a trained critic and not a trained performer. At the same time, there was a great deal in what Mr. Quartermaine had said; one could learn a great deal more by being an important man on a small job than being a young man on an enormous project which swamped one by its very size and which one could not possibly influence at one's own level. Consequently, a lot could be learned in a small company on works of no great magnitude, because the problem of how to do the work was the same anywhere. At the present time letters came from all over the world from engineers who wanted to come to firms in this country. It was much easier to deal with an organisation like the Athlone Fellowship Scheme, which could apply in an organised way to a firm and make an impression on its board and get it to consider the problem. On the question of the Fellows who went to the universities and the question of their getting round the country, it would be useful if those running the scheme could apply to certain firms and make a creative suggestion, because firms were not given to making suggestions themselves very easily.

Mr. H. M. Lacey wanted to emphasise what previous speakers had said about the subsistence allowance. While in this country they undoubtedly could not compete with the salaries of 400 dollars a month, nevertheless the present subsistence allowance was less than some student apprentices who were over twenty-one already received in this country.

Mr. J. Y. Rousseau (an Athlone Fellow) proposed that the scheme be altered so as to include a higher proportion of candidates from Canadian industries than those about to graduate. He understood that this might lead to some difficulties, as Dr. Abbott had mentioned; but he thought it would be possible to overcome those difficulties by the right propaganda. He believed that the following advantages would make it worth while trying:—First, one who had two years' experience in his profession was definitely more familiar with its varied aspects than the freshman; he was therefore more qualified to choose a specialisation which would fit his talents and interests. Secondly, being older and having already shouldered some responsibilities, he would be highly conscious of his time spent here and would make the most of it. Thirdly, at the present rates his two salaried years in Canada would allow him to make some savings, to get married, if he wished, and to arrive in this country free of financial troubles. As Dr. Abbott had mentioned, the Fellow had to dip into his savings. In most cases this meant his father's savings, which was something as unpleasant to the son as it was to the father, and was a problem which attacked the popularity of the scheme. Fourthly, he thought that a graduate who had already spent two years away from his textbooks would be less inclined to go for post-graduate studies. Fifthly, at present the Board of Trade was covering the expenses of a basic practical training in Great Britain which often might be acquired equally well and with an attractive salary in Canada. On the other hand, the provision for advanced training, which did not exist in Canada, would render the scheme very attractive and the only means of obtaining some precious knowledge. In addition, it would give the Fellow a better opportunity to open up new fields for Canadian imports by virtue of his greater knowledge of Canadian requirements—which brought him to his last point. A graduate fresh from university had most probably never studied a machine on a productive basis. That being so, how could one expect him to compare and take note that a certain British product might be as good as or better than the one already distributed in Canada?

Professor D. G. Christopherson thought the reason why universities were popular in some quarters with the Athlone Fellows was the great prestige which the higher degree had in America and in Canada, and that the Fellow was in the position of making himself a minor authority on his particular thing, whatever it was; the position of working with people, some of them international authorities, all of them at any rate responsible for their own departments; working on terms of great intimacy (and perhaps there was no more intimate relationship in the academic world than the relationship between the senior research worker and the junior), and working in a way which, perhaps more than anything else in the intellectual world, gave a feeling of achievement. It seemed to him that it was that kind of position, that kind of personal responsibility, that feeling of achievement, which should be given to the Athlone Fellow in industry. It might well be that if it were found—and he could conceive that it might be found—that the man who had just got a degree was not in a position to take responsibility in industry, for reasons which would be plain to everybody, then the right thing would be to think in terms of the rather more senior man.

Mr. R. U. Law said that his company was running an indentured apprenticeship scheme for the training of civil engineers; 50 per cent of the apprentices were university graduates, and all the apprentices went through the drawing-office, laboratory, workshops and on to a variety of contracts. Wherever they went a senior engineer was appointed their tutor, and it was the tutor's responsibility to guide and help the apprentices in every way. He must ensure that an apprentice was taught and given experience, that he carried on with his theoretical studies, and that he conducted himself properly. Every three months a report was received from all the tutors stating what training the apprentice had been given and how he had applied himself to his training. Under that system the apprentice was kept under constant surveillance, and the firm were able to form a reliable opinion of him, as he had served under several tutors, all of whom had given their reports on his quality and character. He wondered whether a similar system might be applied to the Athlone Fellows.

Mr. F. H. Perkins remarked that it had already been said in the discussion that it did not matter very much whether a Fellow went into industry or into a university. He had himself the feeling that it did matter a great deal, and that it was determined by the individual himself, his background, his circumstances and his desires. In the case of the Fellow who had come to Imperial Chemical Industries, they had approached the problem in this way, that they were most anxious to find what he felt would be the most useful experience that he could gain with the company. The situation had been helped to some extent by the fact that the Fellow had had a short industrial experience in Canada; it had been possible to put him in a position of responsibility in one of the company's largest manufacturing divisions. The Fellow had filled that job very well indeed, within the limits of the requirements of the particular job, and he thought it could be said that, as a result of that experience, the Fellow had been able to gain a good deal of specific knowledge about the actual job for which he had carried responsibility; moreover, he had been in a position in which he had been in day-to-day contact with colleagues throughout the whole of the manufacturing division and had been able to gain a great deal of information about things in which he was interested. Mr. Perkins felt that an advance on the Group B side would be of considerable assistance to the scheme, certainly so far as the practical training in industry was concerned. It seemed to him that if industry in this country could receive men who had had a short experience already in industry in Canada, it would be likely to make the actual training experience in this country much more valuable.

Professor Robertson (of Toronto) suggested that a year in industry should be made compulsory, having in mind the original aim of the scheme. After listening to the

discussion, he had an alternative suggestion which he rather favoured, and that would be to divide the total number of Athlone awards into two groups, one-half or some other percentage going into industry for full time, and the other half going into the universities. If the award of Athlone Fellowships was made on the same basis as all other scholarship awards, then the man with a practical bent who had not a class 1 had not a chance of getting them. Therefore, he suggested that in choosing the Athlone Fellows, the Canadian authorities should interview the men of a practical bent, many of whom would make and did make the finest of engineers. The Canadian people who perhaps took the first step in bringing forward the names might have drawn to their attention that, if the original aim of the scheme was to be adhered to, there were men who were not in what would ordinarily be called the high scholarship level who would admirably fulfil the purposes behind the scheme.

Mr. R. J. S. Pigott (former President of the American Society of Mechanical Engineers) said that after hearing what had been said on both sides of the question, he did not feel that they need worry too much about whether the training should be more practical or more theoretical. It should not be forgotten that the college graduates were not yet fully matured. They had come out with a certain amount of knowledge and the beginnings of some practical sense, but they did not know their own minds too clearly always, and in some cases whatever they learned during the period would be useful to them in finding out their own minds.

Mr. N. G. Treloar said that in the paper two groups were mentioned. Group A concerned men straight from the university, and for them the two-year course was probably right; but he would support previous speakers who had emphasised the need for a one-year course for the Group B men. The Group B man had had some industrial experience, he was older, and presumably he had built up a position of responsibility in his company. It was therefore much more easy for him to be released for the shorter period. He would be able to assimilate knowledge more speedily and the long-term results envisaged for the scheme would not be quite so distant. With the Group B men he thought that they should enlist the co-operation of Canadian industrialists and ask them to nominate the people whom they would like to come over to Great Britain.

Mr. A. T. Holman, referring to the reference in the paper to the difficulty of mining engineering training, said that it would perhaps be possible to give some help in Cornwall. There was in Cornwall not only a mining machinery works which competed with the Americans, the Swedes and others in all parts of the world, but also a mining school which was extremely practical. Many men from other Dominions—from South Africa, Australia and New Zealand—and from Nigeria and Northern and Southern Rhodesia attended that school and obtained very fine practical training. Unfortunately there were none from Canada.

Mr. Slingerland (an Athlone Fellow) said that there was one point he wished to make concerning the purpose of the Fellowships. Were they, he asked, trying to present to the students processes or products? It seemed to him that the most important thing for the Fellows to pick up was knowledge of British products. Processes were pretty well standardised now, even in backward Canada. He thought that a much better way of doing this, rather than to have a Fellow go in and spend his time pushing a file, would be to give him a course in which he toured several companies and got an understanding of each of the companies' products. After all, as far as he could see that was what they were trying to sell. He therefore suggested that they should organise, not simply an industrial scheme which stuck a man in one company and left him there, but a scheme which moved him around and gave him a better chance of understanding what was going on in a larger field.

Mr. Nott said that it must be borne in mind that the whole scheme rested on the assumption that British goods were in fact superior to their American counterparts, and unless this was so (and it was no use being complacent on this question), then it would need an awful lot of pep talk and training to convince the Canadian Fellows that they could in fact do a useful job!

Dr. W. Abbott replied briefly and the meeting ended.

French Cross-Channel Steamer "Lisieux"

By G. W. TRIPP, O.B.E., F.C.G.I., M.I.C.E.

THE service between Newhaven and Dieppe is an old-established one and, before railways were authorised to operate steamships, sailings in connection with the railways were maintained by private companies, the General Steam Navigation Company, of London, being one of them and latterly Maples and Morris. In 1862 the London, Brighton and South Coast Railway and the Western Railway of France jointly obtained powers to own and work steamers, but for about twenty years all of them sailed under the British flag. The vessels employed came from British shipbuilding yards, for not until 1890 did the French begin to build their own ships; they were the products of the Forges et Chantiers de la Méditerranée, of Le Havre, "Angiers" and "Caen" being two vessels of 522 tons gross, which were followed by the larger "Seine" of 808 tons, and "Tamise" of 978 tons. All four were built within a period of three years, and all were driven by triple-expansion engines and twin screws, the four being registered jointly by the two railways.

Subsequently other ships came from the same yard, which to the French Railways was what William Denny and Brothers was to the English railway, and in 1911 two much larger sister ships were built, "Newhaven" and "Rouen" (Fig. 1), these being driven by triple-screw, direct-drive turbines. They had the following principal dimensions: length, 292ft; breadth, 34·6ft; depth, 22·1ft; tonnage, 1656 and 1580 gross respectively. A noticeable asset of these ships was their high speed of 24 knots, which has characterised this route to the Continent, the longer passage justifying the extra knots above those of the ships plying on the short sea passages. In 1919 "Versailles" (Fig. 2) was added to the fleet. She was then the largest vessel engaged on the service, her principal dimensions being: length, 300·6ft; breadth, 34·6ft; depth, 21·4ft; tonnage, 1903 gross. She was a twin-screw vessel driven by single reduction geared turbines.

A similar state of development had taken place on the British side, the "Brighton Railway" being the first to put a turbine steamer on this service, and the first to resort to the use of the geared turbine.

The three steamers "Newhaven," "Rouen" and "Versailles" remained in the service until the outbreak of hostilities in 1939, but some years previously the two first-named had been modified and modernised and considerably altered in appearance, their two funnels being replaced by a single one, oil fuel substituted for coal, and a large part of their promenade decks protected by windows. The different alterations increased their gross tonnage by 300. Two larger vessels had been ordered in 1939, but before completion they were taken over by the Germans, and it was not until 1947 that they were able to be brought into civilian use. These two steamers, "Londres" and "Arromanches," took the place of the three already mentioned which had not justified reconditioning.

The principal dimensions of "Londres" are: length, 308·4ft; breadth, 39·7ft; depth, 23·3ft; tonnage, 2434 gross. Accom-

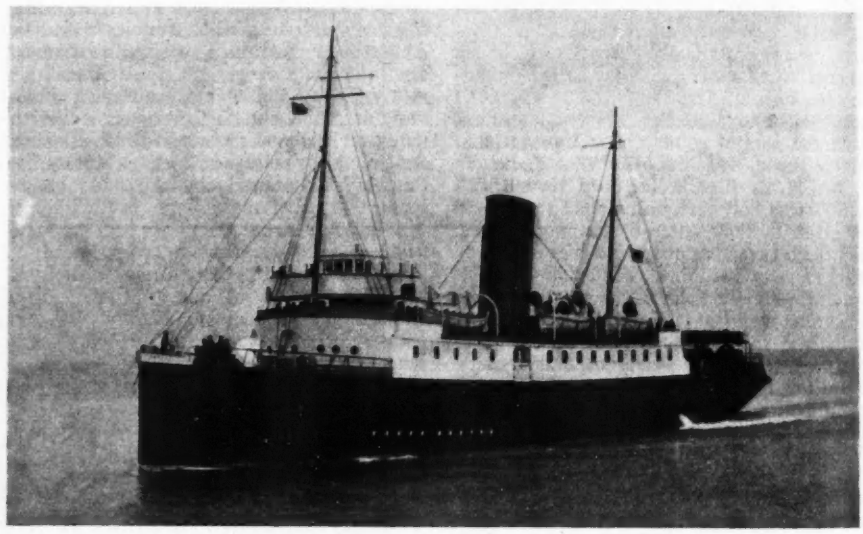


Fig. 1—"Rouen" After Reconstruction Entering Newhaven Harbour

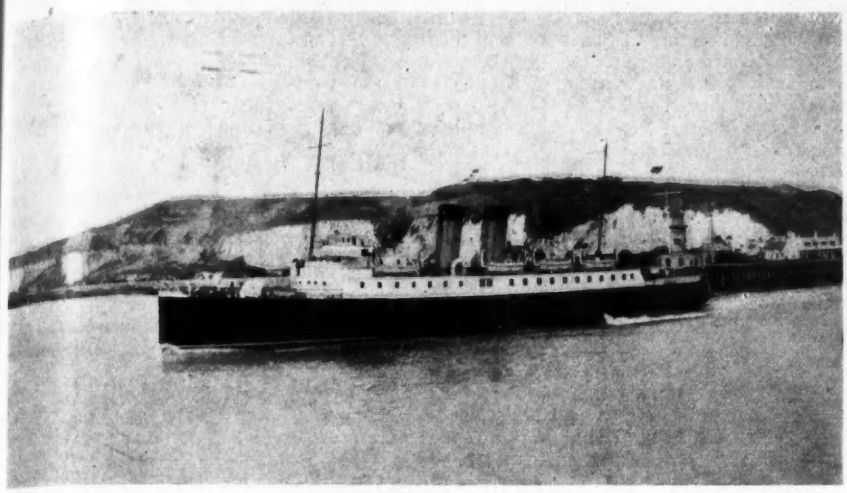


Fig. 2—S.S. "Versailles" Leaving Newhaven

modation is provided for 1450 passengers. Twin screws are driven by six single reduction geared turbines, which give her a speed slightly above that of her predecessors.

On this side of the Channel British Railways' latest contribution to the joint fleet was "Brighton," which appeared in 1950, and was fully described in these pages,* but for the sake of comparison her chief dimensions are given: length overall, 311ft; breadth moulded, 40·5ft; depth, 16·75ft; tonnage, 2875 gross. She has the same passenger accommodation as "Londres."

When it is mentioned that nearly half a million passengers use this route annually it is not surprising that the French National Railways decided to order another steamer, especially as they have only one on their Folkestone–Calais passage. This ship, "Côte d'Azur," has already been described.† Although primarily intended for the Newhaven–Dieppe route, the new steamer will be used to relieve "Côte d'Azur" when necessary.

"Lisieux" (Figs. 3 and 4), the subject of this article, was launched at the yard of her builders, Forges et Chantiers de la Méditerranée, Le Havre, on February 26, 1952, her classification being Veritas 3/3 L 1/1 Channel. Her principal dimensions are: length overall, 314·6ft; between perpendiculars, 308·6ft; breadth overall, 45ft; moulded depth at B deck, 24ft; loaded displacement, 2221 tons; corresponding draught, 10·5ft. The hull of the vessel is Martin-Siemens steel, and welding has been used to a considerable extent. The ship is divided into five watertight compartments, the doors of which can be closed from the bridge.

Steam is supplied by two water-tube "F.C.M. 47/60" boilers, with a heating surface of 8396 square feet, an evaporation of 132,000 lb of superheated steam per hour at 705 deg. Fah., and a working pressure of 426 lb. per square inch. Steam can be raised in thirty minutes. There is also an auxiliary multitubular water-tube boiler with a heating surface of 539·2 square feet and a working pressure of 127·8 lb per square inch. The propelling machinery consists of two sets of Parsons high-pressure-low-pressure turbines developing 22,000 h.p. at a speed of 24 knots. During her trials she reached a speed of well over 25 knots. The turbines drive twin screws, 9·18ft in diameter, at a speed of 400 r.p.m., through single reduction bi-helical gears. Electricity is supplied by four d.c. generators, two are 300kW, 220V turbo-generators, one is a 250kW, 220V diesel generator, and the fourth is a small emergency diesel generator of 60kW, 220V.

As regards deck machinery, the vessel is equipped with a forward rudder, as it is usual to enter harbour stern first. The rudders are operated by hydraulic telemotor control, with an electric motor for each rudder. There are two vertical spindle windlass-capstans forward and one aft, which are driven by steam supplied by the auxiliary boiler to which reference has already been made. Mechanical air conditioning provides excellent ventilation throughout the ship, the pleasant atmosphere in the engine-room being specially noticeable.

There are three main decks, the lettering A, B and C being different from that usually obtaining on British ships, in that C is the highest. On the C deck forward there is an observation lounge, tastefully laid out and with fluorescent lighting; from it good views can be obtained, and in it will be found a bar. Immediately behind this on both sides of the promenade are comfortable seats. Amidships are four *cabines de luxe* and seven two-berth cabins, all well laid out and very comfortable. Astern is a very commodious third-class saloon occupying the full width of the ship, and furnished with leather-covered seats separated by arm rests, available for 105 passengers. Adequate toilet facilities are supplied. Certainly the provision made for third-class passengers is superior to that hitherto obtaining on any of the other steamers. Between the two classes will be found the passport office and that of the purser.

B deck is largely devoted to quarters for the officers and crew, the officers' mess and the engineers' cabins being on the starboard side, while on the port side the crew are given very comfortable accommodation in two-berth and four-berth cabins. Towards the stern is a spacious dining saloon for 108 passengers, available for both classes, and at the forward end there are two large attractive paintings of the town of Lisieux

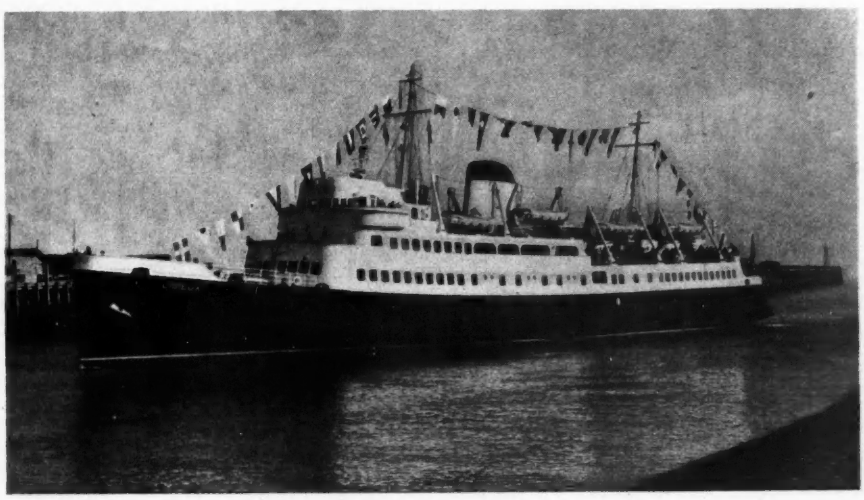


Fig. 4—S.S. "Lisieux" Entering Newhaven Harbour

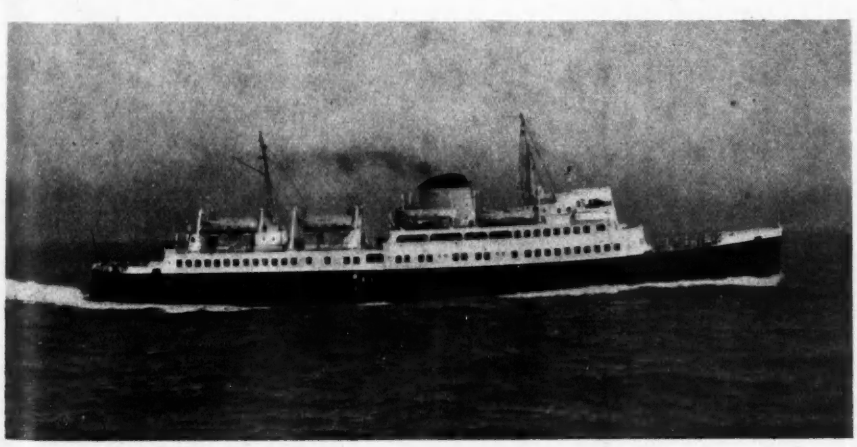


Fig. 3—S.S. "Lisieux," Maiden Trip

* The Engineer, June 16, 1950.
† The Engineer, October 12, 1951.

before the war, and of Lisieux Castle. Still further astern is a third-class gentlemen's saloon with berths for thirty.

On A deck forward is a first-class gentlemen's sleeping saloon with berths for forty-two, and another for ladies with seventy berths. Astern is a third-class ladies' saloon with sixty-seven berths.

The foregoing gives a brief description of the passenger accommodation, but mention should also be made of the comfortable quarters provided on the boat (or E) deck for the captain, with a pleasant sitting room an adjoining bedroom, and a shower bath.

The wheelhouse is roomy and each control is separately accessible. It is equipped with modern navigation aids, including wireless telegraphy and wireless telephony, while there are also installed a Loch echo depth sounder, radar, radio direction finder, and a standard magnetic compass. There is a loudspeaker installation between the bridge, the engine-room and the decks. In addition to the normal instructions to the engine-room as to speed, &c., there is an additional one to draw attention to the emission of black smoke, while in the engine-room itself there is an ingenious arrangement by which the engineer can see the nature of the smoke leaving the funnel. Incidentally, the engine-room deck is not honoured with a letter, but is somewhat ominously alluded to as "fonds." The actual layout of the engine-room, &c., does not call for much comment, as it is in line with the general arrangement now so standard on this class of ship, but it is airy and comfortable and the switchboards, &c., are clear and well arranged. Eight lifeboats are carried.

"Lisieux" arrived at Newhaven on the completion of her maiden voyage on March 24th, and as she berthed immediately astern of "Brighton," the latest British steamer, a comparison between the appearance of them was afforded. While one admires the lines of the new vessel, perhaps the unorthodox shape of her funnel will be considered by some as lacking in beauty; it is similar to that on "Côte d'Azur," which is known as the Valensi "F.C.M." smoke deflecting funnel, and French Railways are evidently satisfied that it fulfils its purpose.

In welcoming the new vessel at Newhaven, Mr. R. P. Biddle, C.B.E., docks and marine manager of the Southern Region of British Railways, said that she had arrived at a very auspicious time, coming, as she did, within twenty-four hours of the announcement by the Government of the increase to £40 of the permitted travel allowance abroad, and he hoped that there might be an increase of a quarter of a million passengers going abroad this year. He also said that he regarded the new ship as essentially French, which he considered an advantage.

Certainly "Lisieux" is a worthy addition to a now modern fleet of cross-Channel steamers linking Newhaven and Dieppe.

The International Motor Show at Frankfurt

No. II—(*Concluded from page 557, April 17th*)

IN contrast to the international nature of the private cars exhibited at the Frankfurt Motor Show the commercial vehicles on display were almost entirely of German origin. Germany's production of commercial vehicles has not progressed at the same rate as that of motor-cars, the total production in 1952 amounting to 106,000 units (compared to 240,000 made in this country) about 45,000 of which were sent abroad. The main export markets were, as in the case of motor-cars, Belgium, Holland, France and the Scandinavian countries, the Near East and Brazil.

To judge by the amount of heavy goods traffic on German roads, in particular on the "Autobahn," one is inclined to think that the German home market is gradually approaching saturation point, and there are certain indications, that with a shrinking home market, the motor industry will make efforts to intensify its export drive, particularly in the field of heavy goods and public service vehicles. In this category German manufacturers have been less handicapped than British firms by those regulations which limit the maximum speed, the axle load and the overall dimensions of vehicles. They could build heavy vehicles, quite acceptable with respect to speed and carrying capacity to many overseas customers, without going to the trouble and expense of developing separate models for the domestic and for the export market.

With fewer limitations imposed on design principles, German constructors in the past have been less conscious of the importance of an economical payload to unladen weight ratio than their opposite numbers in this country, and it seems that quite a number of their larger models were either too cautiously rated or, indeed, heavier than actually necessary. The Germans have realised the existence of this fact and are now trying to adjust it, either by an uprating of existing types, or by the adoption of weight-saving design and manufacturing methods. This applies particularly to passenger vehicles where chassisless body construction and the increased use of light alloys is becoming more general.

It is noticeable that with the exception of Ford and Opel all trucks with a payload of 1·5 tons and more and most buses are fitted with diesel engines and, further, that the majority of firms now favour the rear-engined bus; it may be said that these remarks cover all the tendencies which govern the design of commercial vehicles at the Frankfurt Show. These tendencies are by no means novel nor confined to German designs, but they are distinguished by the variety of diesel engines used. They now embrace units from 1·7 to 20 litres capacity of practically all possible cylinder arrangements, air-cooled, supercharged and two-stroke engines. Intensive development of high-speed diesel engines in the German motor industry seems to have continued since the air-blast, 5·8 litre, four-cylinder engine developing 40 b.h.p. at 1000 r.p.m. which was exhibited by Daimler Motor Company at the 1923 Berlin Motor Show, and a year later the 50 b.h.p. pre-combustion chamber engine of Benz and Cie. Engine speeds have more than doubled and specific output has gone up from 8 to about 22 b.h.p. per litre.

German design deviates in another respect from that of other countries, namely, in its conception of the layout of small vehicles with a payload not exceeding 1 ton, of delivery vans and of very small buses for about eight to fourteen passengers. In this field, the water-cooled, two-stroke petrol engine, in conjunction with front-wheel drive, predominates, though rear-mounted air-cooled engines of the two-stroke (Gutbrod) or four-stroke (Volkswagen) variety have also become popular. Where these vehicles are made by firms which also produce motor-cars (Auto-Union, Goliath, Lloyd, and others) the design follows their particular motor-car practice. In view of the reluctance to use two-stroke engines which seems to be widespread outside Germany, it must be emphasised that the two-stroke engine has been considerably improved in the last decade. Such units up to 1 litre capacity almost equal the four-stroke engine with regard to economy, but are generally superior in simplicity, reliability and ease of maintenance.

In the group of medium-sized vehicles, German design hardly varies from that of other countries. Notable at the Show was a "pick-up" van made by Hannoversche Maschinenbau A.G. (Hanomag), fitted with a 50 b.h.p. diesel engine. Whereas the usual practice is to utilise existing motor-car chassis for this purpose, this "pick-up" has been developed from the 1·5-ton Hanomag truck and, consequently, employs many standard parts of this vehicle. This van (Fig. 9) has an all-metal body, steering

Fig. 9—Hanomag Diesel "Pick-Up" Vehicle

column control and a synchromesh gearbox. It is built to carry a payload of 17 cwt and is mainly designed for export.

Among the medium-sized trucks, was a redesigned "Mercedes" 5·5-tonner, which was interesting because of its combined hydraulic-pneumatic braking system which employs oil pressure for the operation of the front-wheel brakes and air pressure for that of the rear wheels.

On the stand of Büssing G.m.b.H. we noticed a 4-ton truck, fitted with a 5·4 litre six-cylinder, underfloor engine, an indication of this manufacturer's confidence that the still existing reluctance of customers to use underfloor engine trucks may eventually be overcome. At the same stand was an interesting six-wheeler, designed for a payload of 13 tons, propelled by a six-cylinder, 13·5 litre underfloor engine of 200 b.h.p.

These two vehicles were the only underfloor engined trucks at the Show, all the other heavy vehicles being fitted with forward-mounted engines. Nearly all of them were of the bonnet layout, as the introduction of forward control in Germany has met with a certain resistance on the part of the drivers. Among these vehicles was a 20-ton, six-wheeler tripper of Carl Kaelble G.m.b.H., an all-wheel-drive vehicle powered by a 200 b.h.p., 90 litres, V eight-cylinder engine; a 6·75-ton lorry of Magirus Werk A.G., with a 175 b.h.p. air-cooled V eight-cylinder and an 8-ton truck of Maschinenfabrik Augsburg-Nürnberg A.G. (M.A.N.), also propelled by a 180 b.h.p. V eight-cylinder engine.

Of particular interest to foreign visitors were the German bus chassis which, with few exceptions only, all had the rear-engine configuration. They included the "Mercedes" bus, the only German vehicle equipped with a transversely mounted engine and others made by M.A.N., Magirus, Krauss-Maffei and Ford, all fitted with longitudinally mounted engines.

Among the exceptions, there was a Büssing underfloor engine bus chassis, basically similar to that of the previously mentioned 13-ton truck, and propelled by a 15 litre, 200 b.h.p. underfloor engine. It was fitted with the new Voith hydraulic transmission (Fig. 10), which will be described later.

At the stand of Henschel and Sohn G.m.b.H., two bus chassis of rather unorthodox design attracted considerable interest. One was a bus for a maximum load of 4·5 tons fitted with a 100 b.h.p., six-cylinder engine which was transversely mounted at the front ahead of the driver's seat (Fig. 11). The gearbox is flanged to the engine, and a spiral bevel drive, integral with the gearbox, transmits the torque to the rear axle via a longitudinal universal jointed transmission line. Although such a design does increase the available floor space of a bus to some extent, yet compared with the transversally mounted rear engine it would appear that any advantages gained by a simplified engine and gear control are probably outweighed by the long transmission line.

In the other Henschel exhibit, a chassis for a 100-passenger city bus, the designer was faced with the task of accommodating a heavy six-cylinder, 200 b.h.p. engine under the floor, while maintaining a low and uninterrupted floor line. The chassis, therefore, is asymmetrical (Fig. 12); one box-sectioned longitudinal member, 12in wide and 8½in deep, and strong enough to take the torsional and bending stresses, carries the engine mountings, while the other subsidiary box-sectioned member, 7in wide, but only 4in. deep, passes over the cylinder heads. Both longitudinal members are ducted, the main member for heating and air conditioning, the auxiliary member for leading the combustion air from the front-mounted air filter to the inlet manifold.

With due respect to this conception and to the detail design, it is questionable whether a low uninterrupted floor level could not have been obtained with less cost and probably even with a saving of weight by employing a self-supporting stressed body construction. Generally speaking, it seems that, for an output in excess of about 150 b.h.p., the six-cylinder in-line arrangement of normal aspirated engines is becoming so bulky that the accommodation of more powerful units in bus chassis will meet with increasing difficulties. It is likely that in future other cylinder arrangements, probably flat opposed six or eight-cylinder underfloor engines will have to be employed.

Lack of space prevents us from describing the numerous integral steel or light metal body constructions which were shown by several firms, such as Karl Kässbohrer G.m.b.H., Theodor Klatte, Joseph Graf G.m.b.H., and Orion Werk G.m.b.H. The all-steel buses, exhibited by Orion, all fitted with longitudinally mounted rear engines of various makes, were of interest, because by an arrangement of independent wish-bone-cum-coil-spring suspension, front and rear (Fig. 13), the floor height had been reduced to 18in and the step height at the front entrance to 14in. Though independent suspension for bus chassis is still in its preliminary stage, it can be expected that with increasing demands for higher speed and better springing, the independent front-wheel suspension will eventually find wider acceptance, particularly for medium-sized transit coaches. Independent rear suspension might follow later, particularly for rear-engined

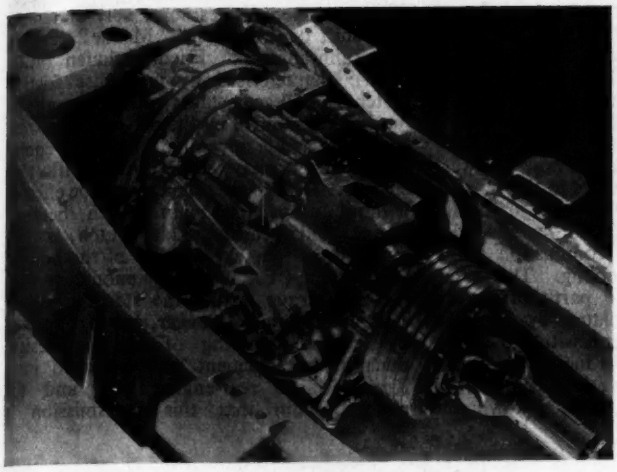


Fig. 10—Voith Hydraulic Transmission in The Bussing Chassis

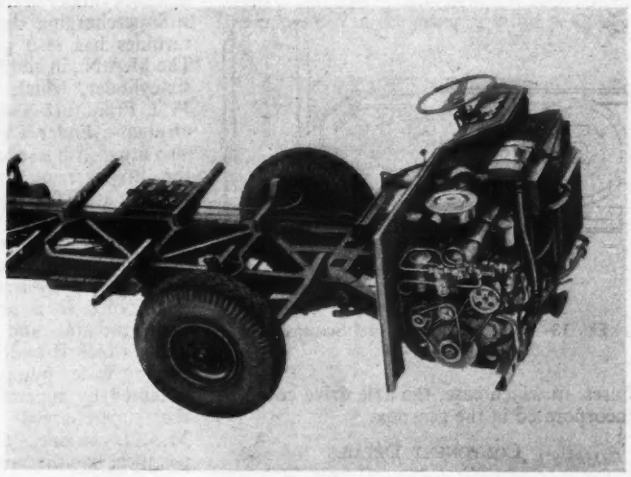


Fig. 11—Henschel Bus Chassis with Forward Mounted Transverse Engine

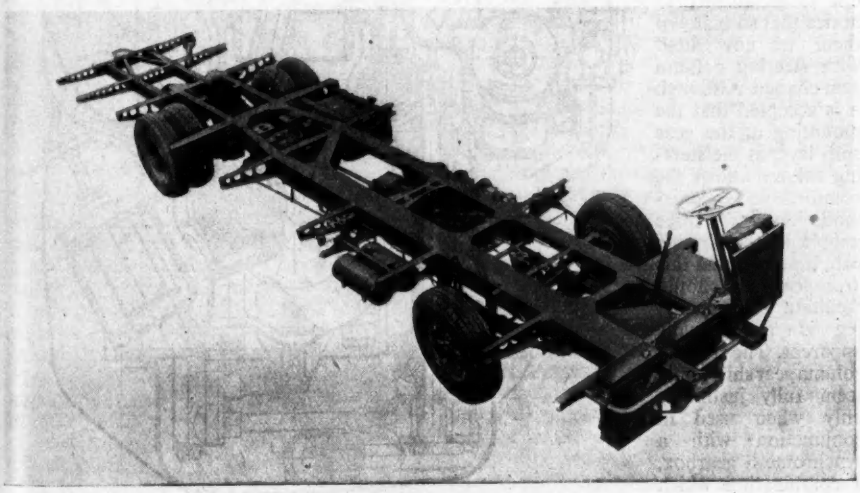


Fig. 4—Henschel Asymmetrical Bus Chassis

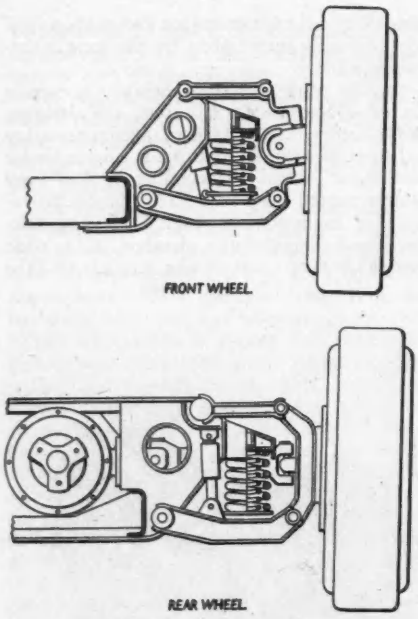


Fig. 13—Front and Rear Wheel Suspension of Orion Bus

buses, in which case, the axle drive could be incorporated in the gearbox.

Component Details

In distinction to the display of new diesel engines at the 1951 Show, engine design now shows only detail improvements. The precombustion chamber engine, with swirl chamber, turbulence chamber, air cell, &c., still predominates and is likely to continue to do so. Its insensitivity to fuel of a varying quality is considered in Germany an asset for engines which are to be exported overseas. Much effort has been devoted to improving the smoothness of running, and a new automatic injection advance made by Robert Bosch G.m.b.H., is beginning to replace the manual control which hitherto was prevalent in German diesel engines. In an attempt to minimise weight and bulk, engine speeds are generally higher than those adopted in this country. The speed of engines between 50 and 100 b.h.p. generally exceeds 2500 r.p.m. (in some cases approaching 3000 r.p.m.), while engines of 150 to 200 b.h.p. run at speeds between 2000 and 2250 r.p.m. Piston speeds up to 2000ft per minute are not considered excessive, as chromium-plated piston rings and h.d. lubricating oils have reduced cylinder wear sufficiently to allow trouble-free operation of at least 100,000 miles between major overhauls. Fig. 14 shows a cross section of a typical German precombustion chamber engine, made by Hanomag. With a cylinder capacity of 2·8 litres the four-cylinder engine of 90mm bore and 110mm stroke develops 45 b.h.p. at 2800 r.p.m.

The air-cooled diesel engines, introduced by Humboldt-Deutz A.G. shortly after the end of the war, are now the standard equipment of all vehicles made by Magirus the sister company of Humboldt-Deutz, and are also fitted to buses made by Krauss-Maffei, Kässbohrer, Orion and other firms. It is claimed that air-cooled engines are superior to water-cooled ones, not only with regard to weight and bulk, but also in wear resistance, as the high cylinder temperature prevents corrosion of the cylinder walls by sulphuric acid, caused by the sulphur contents of the fuel. Progress is also claimed in the reduction of engine noise by improvements in the design of blowers. The other main source of noise in air-cooled engines, namely the piston slap, has been reduced by offsetting the gudgeon pin and by employing as piston material hyper-eutectic Al-Si alloys having a low coefficient of thermal expansion. The existing range of Magirus engines has been further augmented by a six-cylinder V 90 deg. engine of 8 litres capacity (basically similar in design to the 175 b.h.p. V eight), which develops 130 b.h.p. at 2250 r.p.m. (Fig. 15). The engine is sufficiently compact for rear mounting in buses, and it is well balanced ; in spite of the uneven firing sequence, the running is smooth and hardly distinguishable from that of a six-cylinder in-line engine.

Supercharging diesel engines by exhaust turbines has also gained wider acceptance. The M.A.N., in addition to its direct-injection six-cylinder, which was first shown at the 1951 Frankfurt Show, has another engine, an eight-cylinder V 90 deg., 10·6 litres engine, also fitted with a supercharger. Fig. 16 shows the arrangement of the turbine blower, running at 30,000 r.p.m., close to the exhaust valves. Instead of the previously used air-cooled intercooler between blower and inlet manifold, cooling of the combustion air is now effected by water cooling. The water is recooled in a separate partition of the main radiator and circulated by a water pump which is built integral with the engine cooling water pump. The increased output obtained by supercharging is considerable ; the supercharged 8·3 litres, six-cylinder M.A.N. engine, for instance, has the same output of 180 b.h.p. as the eight-cylinder normal aspirated 11·6 litres engine, and the 10·6 litres supercharged eight-cylinder develops 235 b.h.p. compared to 180 b.h.p. with normal aspiration. The torque of the supercharged engine remains practically constant over a wide speed range ; a maximum b.m.e.p. of about 145 lb per square inch and a fuel consumption of 0·35 lb per brake horsepower hour has been obtained at speeds up to 1700 r.p.m.

Looking at the light and medium-sized trucks at the exhibition one is astonished to notice that so many of them are now fitted with steering column gear change. Although it is accepted that the mounting of the gear shift lever at the steering column allows the comfortable accommodation of three people in the driving cab, the claim that this arrangement should facilitate gear changing is not equally apparent. The steering column gear shift would seem fully justifiable only when used in conjunction with a synchromesh gearbox, a combination which is used on the light and medium-sized vehicles of Ford and Hanomag. With heavier vehicles, fitted with the usual constant-mesh, dog clutch gearboxes, gear changing seems more easily effected by the direct centre lever than by the less positive and frequently "spongy" steering column control. Whether or not the synchromesh gear will eventually be accepted for trucks remains to be seen. At present the weight and cost of synchromesh gearboxes appears to be prohibitive for heavy vehicles except city and suburban buses operating in heavy traffic.

Rear or underfloor mounting of the engine, of course, necessitates some sort of remote gear shift control. The "Media" gearbox of Zahnradfabrik Friedrichshafen A.G. (Z.F.), characterised by multi-disc friction clutches in all gear stages with pneumatic or mechanical control by the driver, has proved successful and is now almost standard equipment for all heavy buses fitted with rear engines. Though gear changes can be effected without using the main clutch between engine and gearbox, this clutch is still required, as the gear clutches of the bottom stages cannot be made large enough to take the full torque during the starting period. This main clutch, however, can be replaced by a fluid coupling of suitable design. Such an arrangement was exhibited in a Krauss-Maffei rear-engine bus, and the makers claim that this transmission is

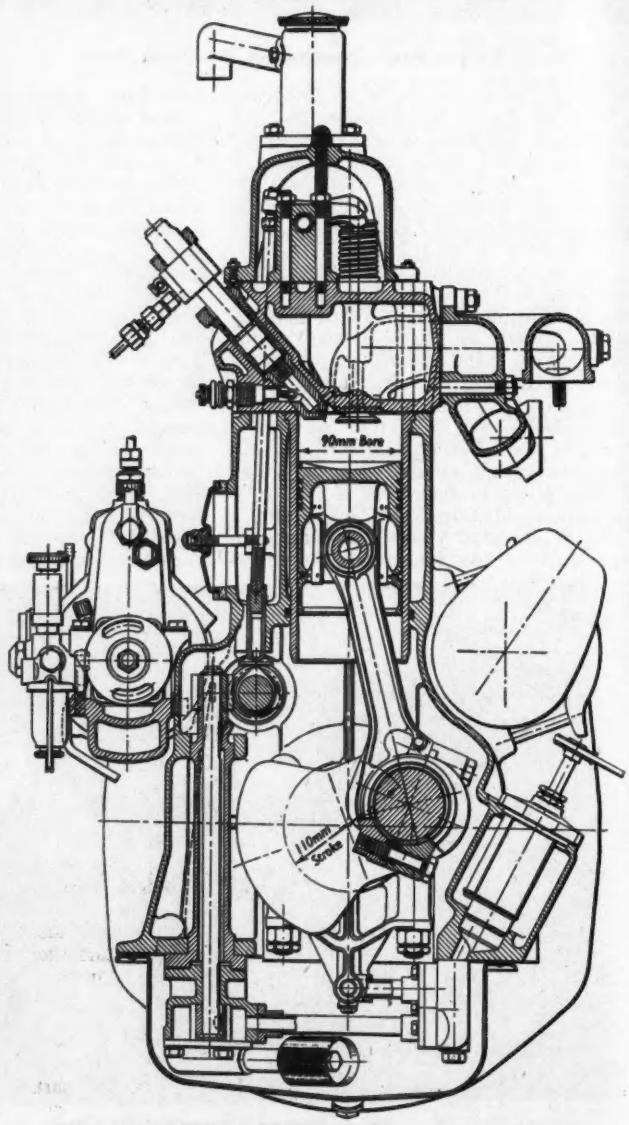


Fig. 14—Section Through 2·8 Litre "Hanomag" Diesel Engine

flexible, easy to operate and imposes less stresses on gearing and tyres than a purely mechanical transmission.

After careful investigation of hydraulic transmissions, German manufacturers believe, as do other Continental firms, that hydraulic torque converters are unsuitable for European vehicles because of their low efficiency at high conversion ratios.

The new "Diwabus" hydraulic transmission, developed by J. M. Voith G.m.b.H. for use in public service vehicles, is an interesting example of how the basic disadvantages of hydraulic torque converters can be overcome. The transmission consists of a hydraulic converter which is connected with a differential "distributor" in such a way as to transmit the intake torque by mechanical as well as by hydraulic means, the ratio of the distribution depending on the torque resistance of the output shaft.

Fig. 17 shows the principle of this transmission in diagrammatic form. The engine drives the planet carrier *A* of the differential distributor *B*, the torque being transmitted to the two sun wheels C_1 and C_2 by the planet wheels *D*. Wheel C_1 transmits the intake torque through the hollow shaft *E* to the impeller *F* of the hydraulic torque converter *G* and through the turbine wheel *H* via the freewheel *J* to the output shaft *K* (hydraulic transmission). Wheel C_2 is keyed to the output shaft and transmits its part of the intake torque direct (mechanical transmission).

As long as the vehicle and, consequently, the output shaft, with its sun wheel C_2 is at rest, the torque converter is compelled to rotate at double engine speed. The converter absorbs the whole output of the engine with the result that with fully opened throttle the engine speed drops to about half its maximum value. During the starting period the torque is mainly transmitted hydraulically until, with increasing vehicle speed and equivalent increase of the speed of the output shaft, the transmission ratio to the torque converter decreases. Engine speed and engine output rise accordingly as does the proportion of the torque which is transmitted by mechanical means. At a predetermined speed of the output shaft the converter is put out of action by the automatic application of the brake *L*, and the whole torque is transmitted mechanically.

At the rear of the hydraulic part an epicyclic gear, consisting of two trains (not shown in the diagram), provides a "low" and a "reverse" speed ratio. The brake bands of the epicyclic gears are pneumatically operated by a small control lever at the steering wheel. The converter brake is operated by oil pressure, generated by a small gear pump which is driven from the output shaft. A linkage from the accelerator pedal governs the flow from the pump and thus determines the point of change-over from the part-hydraulic to the direct drive.

It is maintained that the Voith transmission combines the advantages of mechanical and hydraulic transmission; it transmits the torque to a great extent by mechanical means, i.e. with high efficiency, while retaining the main advantages of the hydraulic drive—its flexibility and automatic adaptability to varying load conditions—in the low-speed range.

In concluding this report, it can be said that the general conception and layout of the newer exhibits seemed generally good, and showed an approach to new problems which was bold and sometimes unorthodox, and detail design was well thought out and executed. There seems no doubt that the German motor industry has overcome the difficulties under which it laboured for several years after the war, and has become a serious competitor to the British industry. It has regained most of its pre-war markets and is vigorously trying to establish new ones, mainly in the field of light, medium-sized motor-cars, and of heavy commercial vehicles. It is in this particular field that our leading position in export markets is most seriously challenged.

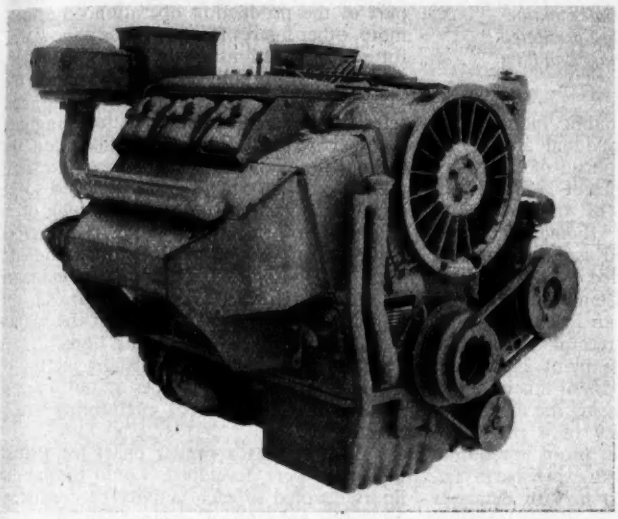


Fig. 15—Air-Cooled Magirus-Deutz Diesel Engine

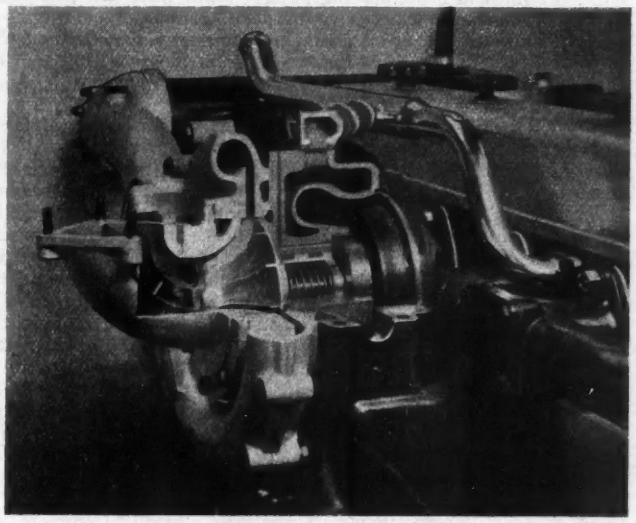


Fig. 16—Exhaust Turbine Supercharger of M.A.N. Diesel Engine

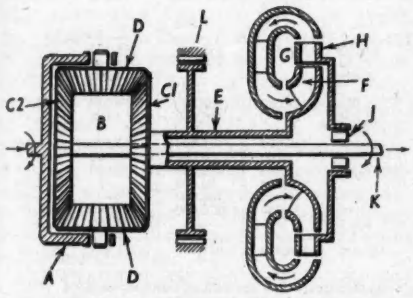
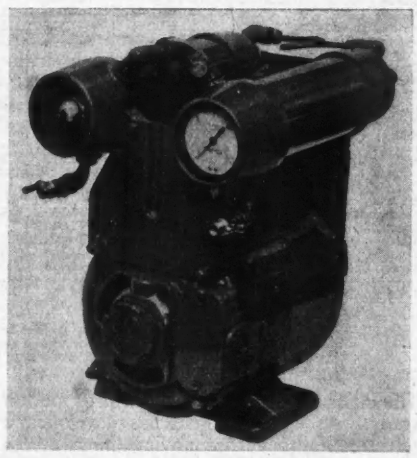


Fig. 17—Principle of the Voith "Diwabus" Hydraulic Transmission

A Small Diaphragm Compressor

A DIAPHRAGM design of compressor with a maximum working pressure of 30 lb per square inch and capable of delivering 2 cubic feet per minute of free air at 10 lb per square inch, is now being made by the Hymatic Engineering Company, Ltd., of Redditch, Worcs. The compressor is built as a complete unit with its ⅛ h.p. electric motor, twin air receivers, built-in relief valve, &c., and forms a compact unit, as can be noted from the photograph we reproduce below.

The compressor has a three-ply diaphragm which is operated by an aluminium alloy piston. The upper end of the piston is in the form of a circular disc upon which the diaphragm is seated. At the top of the compression stroke the disc conforms to the contour of the diaphragm, which has its outer extremities gripped between the main casting and the compressor head. A plate used for holding the diaphragm in position on the disc also houses a ring inlet valve, the ports being extended through the diaphragm and the connecting-rod head.



A Small Diaphragm Compressor

At the bottom the connecting-rod is split to accommodate a sealed grease packed ball race which forms the big-end bearing. A hollow overhung crankshaft is keyed and bolted to the shaft of the driving motor.

The aluminium alloy head sealing the compression space houses a low-lift diaphragm delivery valve and a special chamber designed to damp out pulsation.

American Industry and the Problem of Materials Handling

THE JAMES CLAYTON LECTURE

By JAMES R. BRIGHT, M.S., M.A.S.M.E.*

No. I

Below we print some extracts from the James Clayton Lecture, presented before the Institution of Mechanical Engineers last Friday, April 17th. The aims of the full lecture were to clarify the major objectives of a materials handling programme; to show how progressive companies are organising for materials handling; to describe the scope of the good materials handling programme; the kind of individuals to be placed in charge; the authority and responsibilities to be delegated to them, and the ways in which these activities co-ordinate with, and contribute to, other aspects of the plant. Techniques of analysing materials handling problems and the characteristics of basic materials handling devices were presented briefly. Finally, some fifteen significant trends in American materials handling practice were discussed and briefly illustrated by case examples.

UNDOUBTEDLY, materials handling is the most universal physical activity of all mankind. Man, himself, acts as a materials handling machine throughout the day. And it can be said truly that there is one common denominator in economic life: the act of handling things. The steel mill has little in common with the department store except that materials enter the building, these materials are modified or, at the very least, handled, and then they leave the building. This is so throughout all of industry. One cannot turn an eye on any of man's major endeavours without seeing movement. Yet what has been industry's attitude ?

For thousands of years man has concentrated on the techniques of making things, but he has given relatively little attention to techniques of moving things. To be sure, he has engineered in two areas with considerable success: first, the science of transportation. One cannot deny that engineering miracles have been performed in this field. The other area is the development of motion study. As a result, man has developed a scientific approach for moving things across vast distances, and another for moving things within arm's reach. But what about the gap between ? Is it not amazing that he has ignored, comparatively speaking, this field of "short-range transportation" ?

Everything man makes requires transportation through a sequence of operations. Instead of concerning himself with both of the things involved—(1) the processing operations, (2) transportation between them—man has concentrated on the former, almost ignoring the existence of the latter ! But the latter does exist, and the public, industry, the Government and the individual are paying for the ridiculous anachronism of sandwiching production technologies of 1953 between transportation methods of unknown and unconsidered efficiency. If manufacturing efficiency can be described as actual production operation time divided by elapsed time in the plant, what sort of efficiency does one find ? A recent study on an aircraft specialty item showed that, from receipt to dispatch, the materials were in the plant 240 hours. Slightly more than ten hours of this time was devoted to actually processing the material—a manufacturing efficiency of 4 per cent ! No imagination or further proof is required to realise that this reflects an expensive investment in inventory, which in turn demands excessive storage and handling facilities. This is by no means an extreme example.

Can man call himself an engineer yet confess that he is unable to move materials through a series of processes more efficiently than this ? The answer is that, on the whole, he has not applied himself to the problem.

Why American Management is Concentrating on Materials Handling.—Simple observations of common handling activities should be sufficient to convince anyone that the cost of "short-range transportation" is an enormous part of the production bill. Various studies and numerous estimates in different fields have shown that materials handling costs vary from 30 to 90 per cent of total production costs.

A detailed confirmation is the study shown in Table I. This shows the annual hours attributed to basic operations in the various divisions of a large electrical apparatus manufacturer. It does not cover all operations or all divisions, but does show the most representative operations and their relative importance from the standpoint of labour hours. The significant point is the astonishing size of materials handling activities in comparison with other operations. Time spent for "materials handling" shows an annual labour investment of 8,133,060 hours, compared with the next largest operation, "testing," which consumed slightly less than 4,000,000 hours. The hours shown do not include all handling, but only time recognised and paid for as handling labour. Perhaps 20–30 per cent or even more handling is paid for as "arc welding" or "spray painting," and so on, but is actually recorded by the accountant (and regarded by management) as part of the production operation. Furthermore, other figures from this study show that for every ton of finished products dispatched, 50 tons of some kind of material entered the plant. Fifty to one is a fantastic ratio, and reflects a tremendous materials handling job. Another striking figure was that, for the average product produced by these electrical plants, each part in the products had to be handled about 100 times, either alone or in combination with other pieces. Therefore 1 ton dispatched meant 100 tons handled ! Here is a job to make any thoughtful manager pause. Materials handling labour, at the time this chart was made up, cost the manufacturer about 1·15 dollars per hour. Does not this chart show an astonishing picture of the use of labour, and does it not suggest an area that badly needs engineering attention ?

Assuming that a similar chart for British industries were developed, would the labour hours devoted to each activity be consistent with the amount of engineering attention given to these activities ? For American industry the answer certainly is "no"; materials handling expense is enormous; the engineering attention focused on it is insignificant (in by far the majority of American plants). This presents a major aspect of the growing importance of materials handling as shown by the following :—

(1) Not only is it an unexpectedly large proportion of production cost, but from the viewpoint of management's attention it has been relatively neglected.

(2) Closely associated with this is the fact that management is beginning to appreciate that the "cream has been skimmed off" a good many production techniques.

Doubtless, many would like to argue with the latter thesis; certainly many wonderful improvements will be developed in years to come. However, it cannot be denied that 200 years of experiment and research have

TABLE I—*Major Operations Productive Hours, all Operating Divisions*

Division	Single-point tool turning and boring	Arc welding	Electrical testing	Deburring	Coil winding	Materials handling	Electrical wiring	Soldering and babbitting	Plating	Spray painting	Screw and nut driving	Punch press work	Clamping
Factory service	—	—	—	—	—	1,492,569	—	—	—	500	—	—	5,000
Feeder	—	43,560	—	88,000	—	—	—	—	—	10,000	40,000	—	6,000
Motor	482,304	54,000	351,267	72,000	362,640	—	84,000	79,092	24,000	120,000	84,000	138,720	60,000
Switchgear and control	230,568	647,544	862,884	82,000	211,920	2,234,000	—	253,416	—	178,000	90,000	248,640	135,000
Transportation and generator	—	458,208	222,336	75,000	292,260	—	—	—	—	188,000	60,000	37,200	175,000
Porcelain	54,900	—	12,600	—	—	105,600	—	35,100	—	7,060	—	—	—
Gearing	192,000	—	—	54,000	—	—	—	—	—	6,250	7,500	—	15,500
Micarta	8,400	1,800	—	—	—	528,000	9,984	—	—	—	—	—	—
Bryant Electric Company	88,392	—	74,988	58,000	—	284,835	—	9,984	13,320	10,000	155,000	165,360	3,200
Home radio	8,400	11,520	206,400	—	—	75,000	88,680	54,000	16,380	—	—	11,340	—
X-ray and industrial electronics	75,600	12,492	675,572	95,000	106,560	—	122,280	93,000	38,988	—	—	14,340	—
Lamp	—	43,200	—	—	—	327,200	—	—	—	3,300	—	—	—
Lighting	4,200	4,320	6,000	—	—	36,500	—	—	4,800	11,000	2,200	24,000	4,800
Electric appliance (East Springfield)	541,440	35,712	554,628	63,000	57,876	730,356	138,600	131,664	113,904	10,000	240,000	172,176	8,500
Electric appliance (Mansfield)	117,600	8,400	90,000	127,000	24,000	—	76,800	42,600	144,000	126,000	495,000	453,600	74,000
Elevator	84,000	60,000	7,560	1,200	4,800	171,500	60,000	12,600	—	1,200	6,000	9,000	24,000
Small motor	474,600	52,500	282,600	120,000	200,400	264,000	—	122,400	54,000	50,000	400,000	387,600	60,000
Steam and aviation gas turbine	672,000	942,000	—	76,000	—	—	83,040	36,480	—	130,000	80,000	—	160,000
Meter	—	—	—	63,000	—	—	—	—	—	40,000	168,000	—	2,300
Transformer	100,560	334,560	415,512	78,000	907,704	1,678,800	42,192	258,780	13,104	57,000	220,000	247,788	138,000
M. and R. (five locations only)	143,688	124,428	104,580	—	194,688	204,700	333,912	39,096	6,014	—	—	341,760	—
Total yearly hours	3,278,652	2,834,064	3,902,927	1,052,200	2,362,848	8,133,060	1,039,488	1,168,212	428,510	948,310	2,047,700	2,251,524	871,300

"Materials Handling" is more than twice as large as any other item, and is 26 per cent of the total labour hours. This materials handling figure does not include materials handling work performed by skilled labour as part of normal activities.
(Reproduced from : Mallick, R. W., 1948 (American Management Association) *Production Series* No. 184, "Materials Handling—Current Experience and Evolving Principles.")

* Chief Editor of *Modern Materials Handling* (Boston, Massachusetts).

been devoted, for example, to the machining of metals. Man must be stupid, indeed, if he has not achieved enormous advances. Although equally enormous advances "percentage-wise" may be made to-morrow, they are not likely to produce the same absolute gains as the same percentage of improvement produced yesterday. It is possible, for instance, to reduce the time for machining a part from, say, twenty to ten seconds. Certainly this is a handsome percentage, but, in terms of absolute time saving, it is rather small. On the other hand, that same part may be undergoing a handling or storage activity for at least a thousand times as many seconds. Even so much as 10 per cent saving of this larger time represents far greater dollar saving to the company.

(3) Apart from expediting handling to reduce cost, there is another reason why industry is thinking more keenly of materials handling: handling is the bottleneck in the operation of much high-speed automatic machinery.

Many high-speed production operations, for example, punch pressers, lumber planers, rolling mills, and other production operations that produce material in strip or roll form, find their usefulness distinctly limited because material cannot be delivered or removed rapidly enough. Mechanised handling techniques are absolutely essential to the realisation of the full potential of much high-speed production machinery. An example is the so-called "mile-a-minute" cold-rolled strip mill. Although capable of rolling steel at better than 5000ft per minute, it never operated at more than 3300ft per minute because the coils could not be removed rapidly enough. It was not until 80,000 lb capacity ram trucks were built for this job that full capacity was attainable.

(4) The high cost of labour is recognised by all as being an incentive to perform handling operations mechanically.

There are, however, two further aspects of this problem :—

(*a*) In many cases sufficient manpower does not exist to do the job.

There are handling activities required by the increasing size or speed of production work for which enough men simply cannot be found. A bit of "hindsight" throws a most interesting light on this: a rough computation has been made of the amount of material and distance moved for mineral products handled daily in the United States by belt conveyor. Neglecting lifting materials up inclines and assuming all movement were horizontal and for an average distance of half a mile, how many men with wheelbarrows would be required to move this same daily volume? The answer is staggering—about 10 million! This applies to bulk minerals only.

The United States has another problem with its labour: without passing judgment on the social desirability of this attitude, this fact exists :—

(*b*) In many spots labour is not available at any price because the materials handling activity is so dirty, unsafe, or otherwise distasteful.

Foundries have been one example. Perhaps the British coal industry represents another. To the credit of the foundry industry it can be said that the most modern foundries have been mechanised so that they are as clean and pleasant a place to work as can be found. No dust or dirt clutters the place and no back-breaking labour is performed. Another typical example can be cited in the unloading of meat scrap from box cars. In summer the stench is terrible; in winter the meat scrap freezes into a hard homogeneous mess. It is difficult to get labour to do this job. Even when available, five men take about eight hours to unload a car of capacity 30 tons. Yet one man operating a tractor shovel will do this job in two hours. Whether this improvement is measured in man-hours or dollars saved, or in percentages, the improvement is fantastic; and it is being duplicated in countless other spots throughout every kind of industry.

The Objectives of Materials Handling

Objectives.—Why mechanise materials handling operations? Four major objectives should be considered.

To Reduce Costs.—This is the most obvious reason for mechanising a handling operation. The question is, "What costs?" Many assume that the objective is to reduce the materials handling costs. This is not necessarily true. The ultimate objective of mechanisation is to reduce unit production costs, and this often is quite different from reducing materials handling costs! It may require raising materials handling costs. This consideration throws an entirely new light on the right approach.

To Increase Capacity.—Often the principal idea behind scientific materials handling is to increase capacity. Cost is not the problem. The job is to get more production out of a given machine, a given area, or a given plant.

Sometimes mechanical handling equipment is used, not to increase total production but merely to maintain the same production in less floor space. In other words, to increase capacity per unit of plant area. There is in America a distinct trend toward outdoor storage around buildings and in storage yards. Much money is spent on yard cranes, fork-trucks, straddle carriers, and other vehicles to perform this work. It is not necessarily cheaper to handle things out in the yard than it is in the plant. The principal gain often is that this mechanised handling and outdoor storage technique releases inside space for production machinery.

To Increase Safety: (*a*) *Personal Safety.*—Few people appreciate the number of accidents resulting from the handling of materials in industry. Insurance company studies show that it is the greatest single cause of lost-time injuries. Approximately 6 per cent of the total fatalities occur in materials handling accidents. Over 21 per cent of the permanent partial disabilities, such as amputations and irreparable dislocations, result from handling. Over 25 per cent of the temporary total disabilities—lost-time injuries—occur in materials handling. Since safety records significantly affect workmen's compensation and industrial insurance, management has an added incentive to mechanise materials handling in the United States. This is to say nothing of the humanitarian aspects wherein materials handling saves an incalculable amount of grief, and removes a great deal of day-by-day drudgery from many jobs.

(*b*) *Safety of Materials.*—Plant after plant has shown a reduction in damage to materials and parts, or an increase in quality of the product through scientifically planned handling techniques. For instance, in the field of bulk materials handling, where it is necessary to avoid degradation of the material and minimise chipping, grinding and pulverising, a proper conveyor system will yield a distinctly higher quality product. Fragile objects and objects having surfaces that are easily marred, such as furniture, television tubes, polished sheet metal, glass, mirrors and china, experience less damage with the right mechanised handling methods.

Unit load handling has definitely increased safety of materials for several other reasons: (i) a strapped, taped or otherwise contained or restrained unit load is a definite deterrent to pilferage; (ii) these unit loads, if properly designed, provide both strength and protection to individual parts or packages throughout a long sequence of handling operations; (iii) the sheer number of opportunities for a handling accident are reduced because, say, fifty parts are treated as one handling event, rather than as fifty individual handling events. When this unit load is moved safely it means that all fifty items are moved safely.

To Increase Saleability.—It seems unlikely, indeed, that mechanised materials handling would result in increased sales. However, the facts are that it does in many ways. First, there are many sales situations in which the condition of the product upon receipt is a distinct sales advantage. Makers of coal mining and coal preparation plants have gone to tremendous pains to develop handling systems that minimise degradation and ensure a uniform quality of product. In many operations, ranging from baking bread to mixing chemicals, the trend towards continuous mixing of bulk materials has significantly increased product quality. Instead of mixing by batches, no two of which can be identical without great pains, plants are turning to automatic systems that feed the different items into the mixing system at carefully controlled and interdependent rates. Thus, the product quality and its saleability are enhanced.

Unit loads of finished goods are not only cheaper to load into carriers, but often offer a sales advantage. An automobile manufacturer's materials handling engineer stood at his lorry dock in the receiving area and pointed out to the author the conditions of two loads of nuts and bolts and similar hardware on adjacent lorries. One vendor had supplied this material loaded in the traditional manner; the lorry was an ill-stacked assembly of barrels, kegs and wooden boxes of various sizes and shapes. The other consisted of a neatly stacked group of pallet loads each containing the desired hardware item, in two or three standard sizes of carton. As we watched, an operator with a "walkie-type" powered fork-truck unloaded the palletised load in fifteen minutes. Meanwhile four men were struggling to unload the other lorry; and had completed less than one-third of the job in the same period of time. The materials handling manager turned and said :—

"We simply cannot afford to buy from the manufacturer who will not palletise, or provide us with some convenient form of unit load. That vendor who did not palletise cost us money. As far as I am concerned, his product has a price tag of his purchase price plus our extra handling costs."

Here is a powerful and compelling reason for management to institute better handling and packaging methods.

Realisation of Industrial Possibilities.—When management focuses engineering effort on materials handling to attain the objectives previously described, many benefits result.

What Mechanised Handling Can Do for Management.—(1) Production costs can be reduced significantly. Britain's annual wage bill for manufacturing industries is about £2500 million per year. Probably upward of 30 per cent of this, or £800 million, is spent on materials handling. This could be cut by at least 30 per cent by better handling. Here, then, is £200 to £300 million to be had for price reduction, or other purposes. What might these lower prices do to expand

Britain's markets ? These figures, furthermore, do not include " transport and distributive industries " labour costs, which could also be reduced.

(2) The capacity of a given facility often can be increased.

(3) Where manpower is scarce, or not available, the job can be done.

(4) The quality of the product often can be improved.

(5) Hazards to personnel, hence insurance cost, hiring expenses and production delays because of accidents, are reduced.

What Mechanised Handling Can Do for Labour.—(1) The miserable, back-breaking drudgery of many production activities can be eliminated.

(2) Accidents and disability occurrences, with all their human suffering and wage losses, can be reduced or eliminated in proportion to the reduction in manual handling.

(3) The individual workman has the opportunity to change from a mere " wielder of a shovel " into a machine operator. Indeed, this has been one of the most effective reasons for the acceptance by labour of materials handling in the United States. Perhaps there is something of the small boy in all of us. Whatever the explanation, many workers delight in operating materials handling equipment.

(4) Common labour becomes operative labour. As operators of machines, labour commands higher wages than is possible as manual labourers. Since productivity is so much greater per man-hour, it is easy to support higher " take-home " pay for the individual.

(5) Jobs are less fatiguing. In a surprising number of plants a piece of mechanised equipment has been introduced in one department and the user has become enthusiastic. Before long, the union has requested management to provide similar tools throughout the rest of the plant, even though the total labour force might be reduced.

Wise managements, which let normal turnover take care of a temporary labour excess caused by the introduction of materials handling equipment, have not had too much trouble in selling mechanised handling to their help. Once labour is assured of managements' basic goodwill and that no individual will be arbitrarily dismissed because of the advent of the materials handling machine, they have welcomed and encouraged mechanisation because it makes their work so much more pleasant. The foundry mechanisation programme in the United States is a prime example. It had become next to impossible to get an adequate supply of foundry labour in the dirty, dusty, foundries of yesterday. But the modern foundry is as pleasant a place to work as one could find, and labour welcomes the change.

(6) The worker can do his job for more years, since he is not so dependent on his physical strength.

What Mechanised Handling Means to the Public.—(1) Basically, the public gains through more and better products at less cost. Whether automobiles, television sets, food, refrigerators, or soap, the product is better and the price is lower simply because of superb production techniques based largely upon maximum mechanised production and handling activity.

(2) National output is raised and national strength for peace or war is enhanced.

(To be continued)

WELDING CONGRESS IN HAMBURG.—The Deutscher Verband für Schweisstechnik E.V., Harkortstrasse 27, Dusseldorf, is to hold a Welding Congress at Hamburg from Monday to Friday, June 15th to 19th inclusive.

The 2500 b.h.p. "Deltic" Diesel Engine

Large-scale production is now in hand of the Napier "Deltic" engine, which derives its name from the arrangement of its cylinder banks. This engine has been designed and developed for the Royal Navy by D. Napier and Son, Ltd., Acton, on behalf of its parent company, The English Electric Company, Ltd. The basic proposals for the engine were originally submitted by a Mr. N. Penwarden, who was a draughtsman at the Admiralty Engineering Laboratory, West Drayton.

DEVELOPMENT work on the " Deltic " engine was started in 1947, and by January, 1952, six engines were available with which to carry out full development and endurance trials. Last Monday we were able to see two of these engines installed in a German E boat in which we put to sea. One of the original Mercedes-Benz engines has been retained for manœuvring purposes.

The engine derives its name from the cylinder arrangement and it is a diesel engine operating on the two-stroke cycle and utilising the opposed-piston principle. By its triangular configuration the technical merits of efficiency and mechanical simplicity which are inherent in the opposed-piston design are exploited to the full and its disadvantages eliminated. The components of the engine are small enough to permit the use of modern aero-engine materials and manufacturing techniques, and this has made possible the use of such items as fully hardened crankshafts, thin wall lead-bronzed bearings and case hardened and ground gears, which at the designed ratings give extremely long life.

The engine has eighteen cylinders of 5½in bore and 7½in stroke, arranged in six banks, giving an effective capacity of 5300 cubic inches (86·9 litres). At a crankshaft speed of 2000 r.p.m. it develops 2500 b.h.p., its continuous rating being 1875 b.h.p. at 1700 r.p.m., and it weighs without the reverse gear 8725 lb that is, 3·5 lb per horsepower. The reverse gear represents another 1775 lb. A b.m.e.p. of 91·9 lb per square inch is attained and the piston speed at 2000 r.p.m. is 2416ft per minute. It has the following overall dimensions : length, 10ft 11in ; width, 6ft 2½in ; and height 7ft 1in. It is produced as a self-contained power plant, complete with all pumps and filters and control of both engine and reverse gear is effected by a single lever.

All parts of the engine, both individual components and major assemblies, such as the reverse gear, phasing gear, scavenge blower, &c., are manufactured to be fully interchangeable, and this has allowed the principle of " repair by replacement " to be adopted as a fundamental feature of the design, thus reducing periods of unserviceability to a minimum. Although the engine was produced in the first instance for marine propulsion purposes its technical merits suggest many uses in other fields. In addition to the eighteen-cylinder engine described herein, a nine-cylinder version of the engine is also being produced maintaining the triangular form, but using three-throw crankshafts.

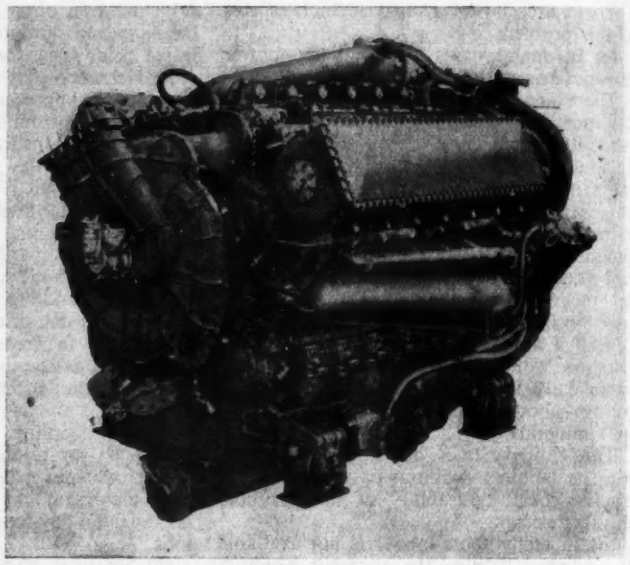


Fig. 1—Free End of "Deltic" Engine

CYLINDER LAYOUT

In cross section the cylinders are disposed in the form of an equilateral triangle, as clearly illustrated in Figs. 1 and 2. With this arrangement it is clear that one crankshaft (in practice the bottom one) must rotate in the opposite sense from the other two.

Two important technical advantages arise directly from this geometrical layout. First, there results automatically a phase angle difference of 20 deg. between exhaust and inlet crankshafts, this phase displacement with the exhaust crankshaft leading permitting the use of an extremely efficient porting layout for scavenging and cylinder charging. Secondly, each crankpin carries one inlet and one exhaust piston, so that the loading on each crankpin, and therefore the power transmitted through each crankshaft, are identical.

When this triangular arrangement is extended through the length of the six-throw crankshafts, each shaft having a normal cylinder firing order (1, 5, 3, 4, 2, 6), the resultant eighteen-cylinder engine has equal firing intervals of 20 deg., this giving extreme smoothness in running.

The triangulated unit which constitutes the main body of the engine is built up from three identical cast aluminium six-cylinder blocks forming the sides and three cast aluminium crankcases at the corners, the two upper cases being essentially identical, but the lower one being deepened in section to carry engine bearers and to provide effective oil drainage. The resulting structure is held together by high-tensile steel through bolts extending from each crankcase through the cylinder block to the other crankcase. These bolts carry all combustion loads, the cylinder blocks remaining in compression. This triangular unit is therefore extremely strong and inherently of great rigidity.

The cylinder liners are " wet " and are machined from hollow steel forgings. They are located in the blocks at one end and water seals are made by rubber sealing members. The bores of the liners are chromium plated and are finished by lapping. Exhaust ports are machined around approximately half the circumference at one end, the bars between the ports being water cooled.

Inlet ports at the other end are provided around the whole circumference and are machined with a partly tangential direction of entry, thus imparting a " swirl " to the inlet air.

Two injectors are provided for each cylinder. They have the outward opening valves principle and both injectors are fed with fuel from a single injection pump. The nozzles inject at a wide

angle from the axis of the injectors, thus delivering fuel at the outer edge of the combustion chamber, the fuel being transported to the centre by virtue of the air swirl which has been referred to earlier.

The pumps are normal C.A.V. units, modified to suit the design requirements of the engine. The six pumps for each cylinder bank are carried on a camshaft casing extending the length of the cylinder block, all three camshaft casings being interchangeable. Rack control is by a rotating shaft, pumps being connected together by small couplings which are torsionally stiff but axially flexible, thus eliminating differential expansion effects. Arrangements have been made in the design to allow any one pump to be removed and replaced by another, correct timing and matching being automatically obtained.

The pistons are of special design and are constructed of two parts held together by a spring circlip. The inner member is machined from a Y-alloy forging and carries the hardened steel gudgeon pin which is fitted tightly in it. The outer member is of cast aluminium having an unbroken skirt and is provided with a cast-in austenitic iron insert in which the two top gas rings are mounted.

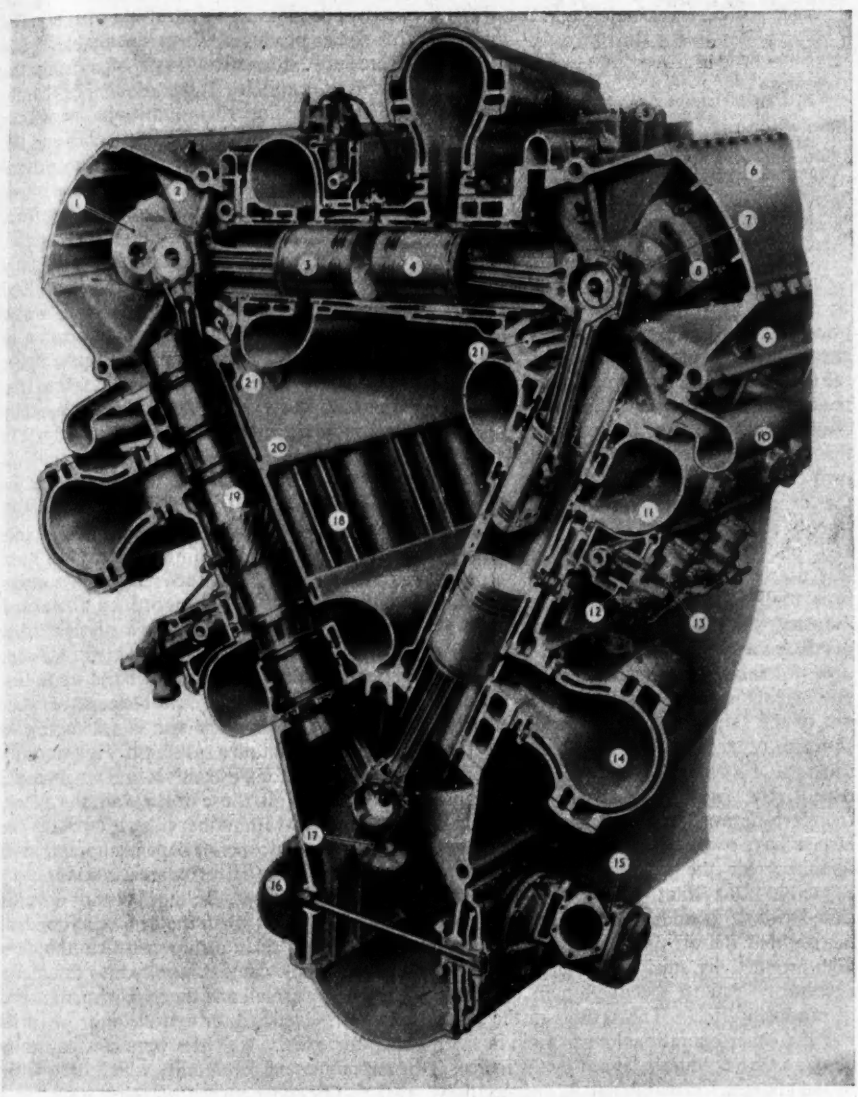
Between the outer and inner members is an annular chamber extending from the bottom of the skirt to behind the gas rings and thence by grooves in the top face of the inner member passing across the underside of the piston crown. Oil is fed into this chamber from the connecting-rod for cooling purposes, escape holes being provided in suitable positions so that cooling is effected by the "cocktail shaker" method augmented by continuous flow.

The connecting-rods are made from high-tensile steel stampings and are machined and polished all over. The pairs of rods on each crankpin are of the "fork and blade" design, the big end of the forked rod being fitted with a steel shell nitrided on its outer surface and carrying in its bore a Vandervell steel strip bearing, lead-bronze lined and lead plated, which runs direct on the crankpin. The outside surface of the shell provides the bearing surface for the blade rod, the big end of which is also fitted with a steel strip lead-bronzed and lead-coated bearing. The small ends of both rods are also equipped with steel strip lead-bronzed bearings. Both rods are rifle drilled for the purpose of feeding oil from the crankpin for small end lubrication and for piston cooling.

Each crankshaft has seven bearings, nitrided all over, the bearing surface being finished by lapping. The main journals run in steel strip lead-bronzed and lead-plated bearings, which are carried direct in the cast aluminium crankcases. Oil is supplied to each journal through oil galleries extending the length of the crankcases and thence through passages in the crankshafts to the crankpins.

Dry sump lubrication is employed and a sea-water-cooled heat exchanger is included in the scavenge circuit for oil cooling purposes.

In the cooling system the cylinder jackets form part of a closed system in which distilled water is circulated through a heat exchanger by a pump on the engine. Sea-water is circulated through the cool side of the heat exchanger.



1—"BC" crankshaft.
2—"BC" crankcase.
3—Inlet piston.
4—Exhaust piston.
5—Crankcase breather.
6—"AB" crankcase.
7—"AB" crankshaft.
8—Main bearing cap.
9—Crankcase tie bolt.
10—Drain oil manifold.
11—Air inlet gallery.
12—"A" camshaft casing.
13—Fuel injection pump.
14—Exhaust manifold.
15—Sea-water pump.
16—Fresh-water pump and pressure oil pump drive gear.
17—"CA" crankshaft.
18—Cylinder block tie bolts.
19—Cylinder liner.
20—"C" cylinder block.
21—Blower flexible drive shafts.

Fig. 2—Section through No. 5 Cylinder Bank Viewed from the Driving End

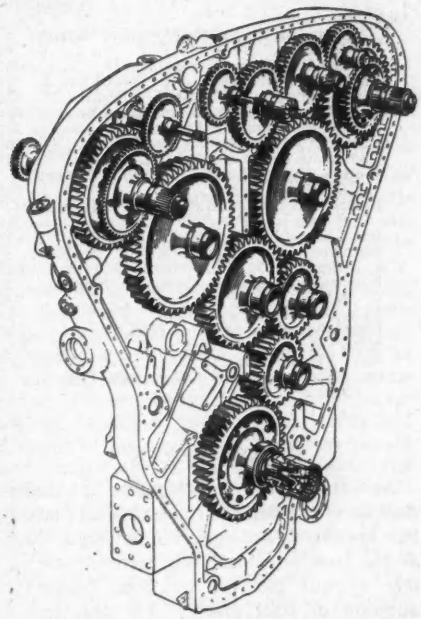


Fig. 3—Arrangement of Phasing Gearing

The three crankshafts are coupled together through a gearing system as shown in Fig. 3, the power from each crankshaft being transmitted through a tributary gear train into a common output shaft at the centre of the triangle; this shaft runs at slightly above crankshaft speed. The connection between each crankshaft and its gear train is made through a flexible quill shaft. By alternative assemblies of idler gears in this phasing system the output shaft rotation can be reversed, the crankshaft rotation remaining unchanged, this providing a method of meeting the requirement for engines having "handed" rotation.

Scavenge air for the engine is supplied by a single-stage, double-sided, centrifugal blower. The impeller delivers air through a diffuser into a casing having three exits, one to each bank of cylinders. It is driven by two flexible shafts connecting with gears at the driving end of the two top crankshafts.

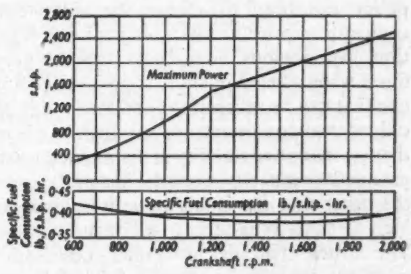


Fig. 4—Consumption and Performance Curves

The reversing mechanism takes the form of two constant-mesh gear systems, one for ahead running and one for astern, the appropriate gear train being connected at will by hydraulically loaded plate clutches. The clutches are connected to the output shaft from the phasing gear train and therefore run at slightly over crankshaft speed. Controls for the clutches are interconnected with the engine power control.

The gear trains in the reversing gearbox also provide appropriate speed reductions, the crankshaft to propeller shaft gear ratios being 2·106in. ahead and 2·397 in astern. All drives are taken from the driving end of the engine.

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STEEL PRICES

An article in the *Monthly Statistical Bulletin* of the British Iron and Steel Federation appears to presage an intention, as soon as the Iron and Steel Bill becomes law, to take up with the Iron and Steel Board the question of steel prices. The anonymous writer of the article first shows, as everyone now knows, that British steel prices are amongst the lowest in the world, very much lower than those of the United States and Germany and appreciably lower even than the prices of the Bessemer steel produced in France and Belgium. He also asserts that "the main reason for the relative cheapness of British steel is not to be found in wide differences in cost, but in the fact that official control has kept the price below the level that would have been established in a free market and below that regarded as appropriate by control authorities in other countries." That policy has, of course, been pursued with the object of stabilising steel prices, whereas, by contrast, Continental policy has been to charge the short-term competitive price. The policy of stabilisation has obvious advantages for users at times when steel is in short supply. But it is one that can be successful upon the long term only if two conditions are satisfied. One of them is that price stability is maintained when productive capacity exceeds demand; and the other that the stable price is sufficiently high to cover long-term costs of production. The article reaches no firmer conclusion upon the latter point than that the question of the adequacy of present prices "merits prompt consideration." It does, however, refer to the fact that under the Schuman scheme Continental makers may seek greater stability in prices so that in a time of slump British prices might not be driven down by Continental competition; and it does emphasise that, whereas in the United States the gross profits amount to £27·5 per £100 employed, of which a surplus of £5·2 is retained to finance expansion, in Britain gross profits amount to only £14 per £100 employed, of which only £2·7 are retained.

No user of steel is wholly indifferent to its price. Some, however, are relatively so because they put so much subsequent work into the fabrication and machining of the steel. At the other end of the scale there are users who change the product of the steelworks so little that the cost of steel is a prime factor in their own costs. An increase in the cost of steel, for example, would be immediately and heavily reflected in the costs of shipbuilding and of structural engineering in general. But users are not only interested in price. It is to their advantage also that the steel industry shall always have sufficient productive capacity to meet the demand. Even now, for instance, though there is no longer any real shortage of steel in general, the output of the shipyards is being restricted by a shortage of steel plate, and to make up that shortage plates will need to be bought, expensively, from abroad. The user must therefore desire that the steel industry shall always have available the financial resources necessary for the expansion of productive capacity. But what is not always appreciated (for it is undeniably a disappointing fact) is that the provision of a new modern, high-productivity steel works may not at all necessarily lead to a reduction in the costs of producing steel. The savings in the wage bill and other operational costs may, in fact, be more than counterbalanced by the increase in the charges for maintenance, depreciation and interest upon the capital invested. Where that situation rules it becomes a disagreeable fact that an expansion of steel-making capacity only becomes economic, and can only be encouraged, if the price of steel, far from being lowered, is raised. Fortunately it does not rule for all steel products. Furthermore, there is another fact whose realisation may not prove welcome to all steel users. If the best is to be got out of a modern highly productive plant it must be run in such a way that it can prove highly productive, that is, there must not be constant changes in the product. That point is well understood in mass production engineering factories. It applies equally to many steel products. Thus, it may be, as the steel industry concentrates its output more and more in modern plants, that it will become increasingly intolerant of small "runs." It may, in fact, desire to follow the lead of the American industry and charge increasingly punitive prices for products that are outside a restricted list of standards.

Some of the consequences of steel output expansion just mentioned seem inescapable. But there is one question that remains to be discussed. Who ought to provide the capital without which the industry cannot expand its output? If it is to be drawn out of ploughed-back profits, then the present provision, as revealed by the anonymous article in the Federation's *Bulletin*, scarcely seems adequate and the raising of the prices of some products seems inevitable. But there are alternative ways of raising the necessary capital. It is, of course, hardly worth discussing them until the new Iron and Steel Board has come into being and the industry has begun to be returned to private ownership. But it does deserve emphasis that the nation derives export advantages from the existence of relatively low steel prices here. Those advantages ought not lightly to be given up. The engineering and allied industries, more particularly those in which the cost of steel forms a high proportion of total costs, will not be content to pay higher steel prices unless convinced that the true long-term costs of an adequately expanding steel industry cannot economically be met in any other way.

AN EXHIBITION OF WORKS RELATIONS

No one could pay a visit to the Thorncliffe Works of Newton Chambers and Co., Ltd., as we did last week, to see a new works exhibition that has been opened there and is illustrated on another page of this issue, without becoming aware that an attempt is being made by the firm to build up industrial relations upon a fine concept of what they ought to be. The aim is not merely to create and maintain a satisfactory relationship between directors, executives and workpeople but between all those three and the whole communities within the villages around the works whose prosperity depends upon that of the firm. There is, of course, nothing very new in that concept. In those distant days, as far back as 1793, when the firm was founded, that kind of relationship between the firm and the people came naturally into existence. The firm was small and the man who managed its affairs lived within a stone's-throw of its blast furnaces. Activities were carried on by a self-contained community which drew little real distinction between working hours and leisure hours, regarding both as necessary to the enjoyment of a full life, just as many a countryman does to this day. Nor at that time was the firm unique. There were plenty of others like it. But increasing industrialisation and the development of new production techniques during the nineteenth century and even more so, perhaps, in this one, have wrought a change. Many working men to-day draw a very sharp distinction between work and leisure. Their place of work is the factory from which they draw their money. The interests of their lives are found outside it. It is that division that the directors of Newton Chambers are trying to break down.

Of course, the directors of Newton Chambers are not alone in striving to create warmer relationships within the firm. There are plenty of other firms, particularly amongst

those of longer foundation, which traditionally care deeply for the interests of their workpeople. Those firms have built housing estates, provided recreation grounds and encouraged their employees to join works societies, striven, that is, to build up a sense of community within and without the works; and they have, too, beneficently looked after the health of employees. Those firms have led the way; and where their efforts have been successful there has been built up an *esprit de corps* antagonistic to "sit-down" strikes, "go-slow" and many other actions indicative in large or in little of unsatisfactory relationships. Yet very often we think there has still been a failure to break down the sharp division between working and leisure hours. Work has remained not something to be enjoyed but something to be done for as few hours as possible each week for the heaviest possible pay packet. Nor, we confess, is it easy to see in some factories how that sharp division is ever to be broken down. Can, for example, the mass production worker who spends each working day endlessly repeating the same series of actions be expected to "enjoy" his labour and regard it as making a satisfactory contribution to the fullness of his life? What Sir Harold West and his co-directors are striving to bring about at Thorncliffe is that both at work and at play employees of all grades shall feel they are contributing something of value, not merely to that rather cold abstraction, the firm, but to the warmly human community which is the firm, and that that contribution, both in working and in leisure hours is appreciated and valued by the community as a whole. The sharp distinction between work and play is, in fact, being blurred. Satisfaction is to be gleaned equally from both. One of the objects of that exhibition which we went to Thorncliffe to see is to make clearer to employees of the firm what character the firm has, what it does, what kind of people work for it, what they do with their leisure, and what part each of them plays in maintaining its interests and its prosperity.

We confess to some little doubt whether the exhibition really attains its objective. For—perhaps we are wrong—modern methods of display in such exhibitions often seem to us to succeed only in touching their subjects superficially. For ourselves, indeed, we gained a much clearer perception of purpose by studying the firm's methods of training apprentices. It is very generally appreciated, nowadays, how violent and disturbing a transition it is for boys and girls leaving school to be suddenly thrust into the totally different atmosphere of a works. Many firms, therefore, attempt to ease that transition by adopting a welcoming procedure of lectures, tours of the factory, &c. and give the young entrants a period in which to settle down before, under mature guidance, they choose what is to be their vocation. At Thorncliffe the whole process of entry and training is more carefully planned than usual. In effect, indeed, the young people join a vocational college which provides hard physical as well as mental and vocational training. "*Mens sana in corpore sano.*" Here they start their association with the firm. At intervals in their apprenticeship they come back to it for further short courses marking further steps in their vocational progress. At the end, just before "call-up," they are given a pre-National Service course to introduce them to Service life. During this whole period of training, they cost the firm far more than the firm receives back from their work. But the justification of all the care that has been put into the courses is that so high a percentage as 85 per cent prefer to come back to the firm upon completion of their National Service. Undoubtedly at Thorncliffe, as anyone can discover by studying the firm's methods of training its apprentices, an intensely interesting experiment is being carried out in industrial relations. It may well bear rich fruit in the future.

Obituary

A. J. W. McINTOSH

We regret to record the death of Mr. A. J. W. McIntosh, chief engineer of the Crawley Development Corporation, which occurred suddenly on April 15th. Mr. McIntosh was fifty-three years of age.

Arthur John Whyte McIntosh was born at Dundee, and, after service in the first world war, he studied engineering at St. Andrew's University, where he graduated in 1924. He then entered a career of municipal engineering, during the course of which he obtained a wide and varied experience with several city or borough authorities, including service with the borough engineer of Oldham, and the city engineer of Carlisle. When he was with the Carlisle Corporation, Mr. McIntosh was assistant in charge of design, and later in charge of the works for the Eden bridge at Carlisle, a five-span reinforced concrete arch structure. In 1933 he became deputy to the city engineer of Aberdeen, and remained in that post until 1948; during that period he was associated with a considerable volume of work which was in progress at Aberdeen, including six bridges, sea defences, main drainage, and a number of other works, including civil defence works and services during the war.

In 1948, Mr. McIntosh was appointed chief engineer of the Crawley Development Corporation, several months before construction of the new town was started. To many municipal engineers such a post must seem an ideal opportunity involving the complete planning of the engineering services and layout of an entirely new town. As may well be imagined, such a situation gives opportunity for the introduction of more rational and advanced ideas than may be possible in a town which has been established, and has grown gradually, over many years. The successful results of several years' work are now becoming apparent at Crawley, for which no little credit is due to the late chief engineer. A description of the engineering works of the new town was given in our issue of September 21, 1951, which gives an idea of the care and thought which has gone into the town's development. Particular interest has been shown in a number of new developments in the work at Crawley new town, such as the experimental length of prestressed concrete road, the first to be laid in this country. Apart from specific engineering design, however, Mr. McIntosh had to consider numerous wider problems in the layout and servicing of the new town, including, for instance, investigations into the provision of district heating and of new methods of refuse disposal, the layout of the road system to ensure the best conditions of road safety, and the design of street "furniture," to mention only one or two of the many problems involved.

Mr. McIntosh was also the chief engineer of the Weir Wood Water Board, a regional water supply board supplying Crawley and various neighbouring districts. He became a member of the Institution of Civil Engineers in 1944, and served on one of the committees of the Road Research Board. He was a member of the Institution of Mechanical Engineers, and of the Institution of Municipal Engineers.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

LIBRARY SERVICE FOR INDUSTRY

Sir,—From the correspondence which has appeared under the above heading, more is gained in obtaining a knowledge of the characters of the writers than in reaching a conclusion from the views expressed. It is a great pity, though one of the failings of human nature, that each service in industry, or in any branch of activity for that matter, seeks to justify its superiority over another branch instead of recognising that each is the complement to the other. It is obvious that an information officer will be biased in recording the merits and efficiency of his own sphere of activity just as the librarian will be in his own sphere. The truth is, of course, that in industry the most efficient service is a combination of both and that the difference lies in the designation of the person carrying out the functions. This is sufficiently proved in the foundation and existence of the Association of Special Libraries and Information Bureaux, where all the services are successfully amalgamated into an efficient system.

Mr. McKenzie is only partly right when he states that the information officer has appeared in industry in response to a felt want. This is truer still of the industrial librarian. He would have been nearer the mark had he said "appeared in industry in response to a felt want," for though the information officer is a relatively modern member of the industrial team, the librarian (except in a few cases of very large firms) is still more recent and is surely superseding the information officer because the librarian, far from being a distributor of technical literature only, is a recorder and cataloguer and whilst organising and building up the library service is, at the same time, organising and building up an efficient information service. Thus, he has the qualifications of two offices and not one as in the case of the information officer.

This is equally true, not only of the industrial librarian, but also of the technical librarian of the public library, particularly so in one so efficient and so closely connected with industry as the Science and Commerce Library in Sheffield. Although there is here an information department, it is chiefly for general information and questions of a technical nature are generally referred to the Science and Commerce Library, which thus fulfils, and very efficiently, the two services about which your correspondents prefer to differ.

Often an information officer has been introduced into industry before the establishment of an industrial library and therefore resents a change of designation even if he is asked, as has happened in many cases, to build up a library system. Often the library system is inefficient because his interest is mainly centred on his original appointment, the designation of which he retains. The industrial librarian, however, whilst building up his library system, has, as previously stated, organised at the same time his information service and one does not suffer to the success of the other. He has therefore combined the two services and still is known as the librarian. Many of the very large firms are able and do maintain an information officer

and a librarian, not because the services are different but because the amount of work justifies a division of responsibility for each branch, In general, however, they are only a division of activities, which in their functioning are still combined under the authority of the research director. Surely this is what is expected, desired and appreciated by our employers, that all work is complementary towards attaining an efficient result.

HAROLD K. STYRING, A.I.L.
Sheffield, April 18th.

SIR,—It is disappointing to find (in your issue of April 17th) that Mr. Arnold, with whom I have had the pleasure of many friendly personal discussions, should suggest that I judge all librarians only by their representatives in public libraries. I have made a considerable study of the whole position and although there are a (very) few individuals with both librarian's and scientific qualifications who are very competently carrying out information work, the results of other librarians' information services fall far short of the information officer's practice. The librarian may locate a book or paper, lead the inquirer to the actual information or (sometimes) extract the factual information for him, but he does not and cannot, as a research scientist would, produce the information in relation to its background and research implications and with the readiness to discuss further its meaning and usefulness. Herein lies the whole difference in the approach of the information officer, as a research scientist specialising in information, and acting as the *alter ego* of his colleagues at the bench or in the office. Even this is not the whole story, which may largely include the gathering of information by personal contacts and without the use of a library (as Mr. A. R. Smith emphasised). Librarianship is at best the body without the soul.

The outlook Mr. Arnold asks for is thus the research outlook and cannot be confined within a short definition. The techniques are largely, it is true, known to the better special librarians, but some techniques, such as those of technical translation and (sometimes) abstracting, editorship, patent searching, &c., are normally outside their field. My references to technical liaison and elements of publicity and public relations were made, not in order to justify the existence of information officers, but to illustrate the still fluid and developing nature of the profession. We do not need to justify our existence : as Mr. McKenzie points out so pertinently, we exist in response to a felt want in industry, a want which librarians have rarely been able to satisfy. Professional qualifications in librarianship already exist and their standing is zealously upheld. If recognised qualifications in information science were established, would not such capable "research librarians" as Mr. Arnold find them more desirable ?

J. FARRADANE,
Scientific Information Officer,
Tate and Lyle Research Laboratories.
Keston, Kent, April 17th.

Books Received

Mechanics : Part II, Dynamics. By J. L. Meriam. London : Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 32s.

Problems in Hydraulics. By R. S. Paradise. Glasgow : Blackie and Son, Ltd., 17, Stanhope Street, C.4. Price 17s. 6d.

Photo-Electric Multipliers. By S. Rodda. London : MacDonald and Co. (Publishers), Ltd., 16, Maddox Street, W.1. Price 22s. 6d.

Principles of Aerodynamics. By Daniel O. Dommasch. London : Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 45s.

Solution of Problems in Strength of Materials. By S. A. Urry. London : Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 20s.

Literature

Practical Clock Repairing. By DONALD DE CARLE. London : N.A.G. Press, Ltd., 226, Latymer Court, W.6. Price 30s.

As a source of instruction on the work involved in the maintenance and repair of domestic clocks, this book is commendably thorough and up to date. It is clearly designed as a companion work to an earlier volume by the same author, which dealt with the repair of watches, and its planning and general layout follow the same lines.

After a brief introduction, which states very clearly and concisely the field covered by the book, the first chapter is devoted to a description of the kind of workshop and the equipment of tools that Mr. de Carle considers necessary for good work.

From the workshop the book proceeds to the clocks themselves, and the second chapter, entitled "Examining the Movement," indicates the way in which a clock movement should be examined and checked before dismantling in order to determine what defects are present, and what work is necessary to rectify them.

The method of careful examination of each assembly and part before removal, in order to detect possible defects, is a sound one, for if this is not done the need for repair or correction may not be apparent until the clock is completely reassembled, a state of affairs leading to much loss of time and temper. In addition to describing the proper procedure for examining and dismantling a clock movement, this chapter also touches on the action of the recoil escapement, the form usually found on domestic clocks, and gives some hints on the correction of some of the more common defects of this assembly.

The third chapter deals with the final stages of dismantling, and then covers such items as the polishing of pivots and the fitting of bushes, both important stages of clock repair. At the end of this chapter, the latest range of tools for "friction tight" bushing is described. As this system is rapidly becoming the accepted one, these hints should be of great service.

The correct methods of cleaning and reassembling clock mechanisms are next explained. Here, again, modern methods, such as the use of the clock-cleaning machine, and the most up-to-date types of mainspring winders, are described in a very clear way. The description of the American "immersion" method of cleaning is a little surprising, and it seems open to question whether such a complex piece of mechanism as a clock can be really effectively cleansed by such a process.

The subsequent chapters are entirely devoted to matters connected with gearing. One section is concerned with the more practical items, such as pitch, tooth-form depth, and sizing. The next section turns to calculations of gear trains, and explains the methods used to determine the numbers of teeth of missing wheels and pinions, and the ways that the correct ratios can be obtained by alternative train arrangements. The table of clock trains with various lengths of pendulums, and the smaller table of suitable train arrangements for the twelve-hour dial motion wheels and pinions, are both valuable reference data.

Striking clocks and chiming clocks are then dealt with in detail, and very little seems to have been missed by the author. A very complete and well-planned oiling chart for an average clock of each type is included in the illustrations, and a look at the two diagrams devoted to a quarter chiming clock will surprise many people, for it reveals that a clock of this kind has many more "oiling points" than the average car !

In a long chapter on the pendulum, thorough and instructive treatment is given on both the theoretical and practical aspects of this important component. The various methods of obtaining compensation for temperature variations are shown, and the use of "Invar," and the effects of barometric variations are also included. Tables of pendulum lengths in comparison with their vibrations per minute, and of the changes of rate in relation to alterations of arc, are useful parts of this chapter. The practical difficulties met with in connection with clock pendulums, such as the errors introduced by infirm cases, incorrectly made supports, and so on, are the subject of a lot of sound advice, and if the points mentioned are studied, the cause of a lot of mysterious stoppages and errors of timekeeping, particularly in "long-case" clocks, will be explained.

A complete section deals with the making of a fusee timepiece, of the type often to be found in the better kinds of wall-dial clocks. Though it is not, strictly, clock repairing, the subject of these chapters is both interesting and instructive, and is of value in that it teaches the reader a considerable amount of horological work that will be of constant use, whatever his connection with clocks. In addition, it will be a part of the book that many readers will put to good use, for there can be few horologists, amateur or professional, who do not wish to have the joy of making a timekeeper throughout, and of seeing it at work. For such enthusiasts, these chapters give very complete guidance, and if they are followed the results should be highly satisfactory.

In a chapter on French clocks covering the usual kinds of pendulum movements, detailed instruction is given on the more complicated forms, such as carriage clocks, repeaters, alarms and strikers, all of which have decidedly individual and specialised mechanisms. Most of the matter on the alarm clock is written around the popular "Smith" alarm, though most of the hints and suggestions are equally applicable to all alarm clocks.

The Composition and Assaying of Minerals. By J. STEWART-REMINGTON and W. FRANCIS. London: Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey. Price 17s. 6d.

THIS book attempts much and it is unfortunate that it achieves so little. To deal adequately with the qualitative and quantitative analysis in a volume of 127 pages is probably impossible and it is hardly surprising, therefore, that Remington and Francis' work has defects. Some of these defects are the more serious since they are not inevitable even in a brief treatment ; the authors, for instance, appear to regard the terms "mineral" and "ore" as being synonymous—"Blende is one of the most important ores of zinc."

A number of the procedures recommended for quantitative assays seem to be ill-chosen, and in few cases are the descriptions sufficiently detailed to enable an inexperienced operator to conduct the assay satisfactorily. So far as the qualitative tests are concerned, the title of the book is entirely misleading ; the tests described are carried out with pure salts of the metals concerned and comprise those normally dealt with in elementary qualitative-analysis texts.

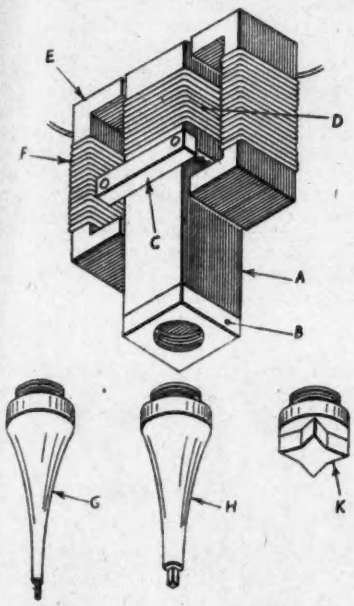
The Physical Society's Exhibition

No. III—(*Concluded from page 569, April 17th*)

THE thirty-seventh annual exhibition of scientific instruments and apparatus organised by the Physical Society was held at Imperial College, London, from April 13th to 17th. A tour of the exhibition provided ample evidence of the increasing use of electronics not only in laboratory apparatus but in industrial equipment as well. This trend is exemplified in some of the exhibits here described.

Mullard, Ltd.

One of the many possible applications of ultrasonic vibrations was illustrated by Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2. This company gave a demonstration of a reciprocating drill operating at ultrasonic frequencies. In this piece of equipment*, the essentials of which are depicted in Fig. 10, a high-Q magnetostriction transducer *A* is operated to generate vibrations at about 22 kc/s and these vibrations are transmitted through a tapered metal stub, *G*, *H*, to a drilling tip. The tapered stub acts as a velocity step-up transformer and the amplitudes obtained from this arrangement are sufficient to allow rapid drilling and cutting of many brittle materials, provided that a paste of carbide abrasive is fed to the drilling tip. Because there is no rotary



A—Laminated transducer
B—Tapped steel tool holder
C—Clamped node
D—Energising coil
E—High permeability laminations
F—Polarising flux winding
G, *H*—Tapered stub transformers with tool tips
K—Heavy tip without transformer

Fig. 10—Ultrasonic Drill—Mullard

motion the reciprocating drill is particularly useful for drilling holes of other than circular shape and for making cuts and depressions in materials that are difficult to machine by more orthodox methods.

In the case of a heavy tip for drilling a hole of comparatively large area the step-up transformer can be dispensed with and the drill tip becomes an appendage of the transducer face, as at *K*, Fig. 10.

The same company also exhibited a newly designed "very-wide-band" dummy load for radio frequency power measurements. With this equipment it should be possible to avoid some of the difficulties associated with r.f. power measurement in which it is necessary to ensure correct matching to the source.

The apparatus (Fig. 11) takes the form of a short coaxial line filled with carbon tetrachloride, the inner conductor consisting of a very thin gold film on a glass rod. This presents a purely resistive input impedance of 75 ohms at frequencies from 100 Mc/s upwards. The power absorbed by the dummy load is determined by measuring the temperature rise in the carbon tetrachloride cooling liquid between inlet and outlet of the dummy load. The rate of circulation of the cooling liquid is regulated with the aid of a flow-meter incorporated in the instrument.

The maximum power handling capacity of this new dummy load is 600W and, in the particular application for which this equipment was developed, the power measurement accuracy is stated to be $\pm 1{\cdot}5$W or ± 2 per cent, whichever is the greater.

In the design of this form of dummy load the comparatively high resistance of the inner conductor results not so much from the specific resistance of the metallic film but from its extreme thinness. This film has a very small cross-sectional area. The actual surface area available for cooling, however, remains quite large and the power handling capacity of a thin film resistor under these conditions is unusually high. To obtain uniform power dissipation throughout the whole length of the inner conductor, the resistance of the gold film on the glass rod is graded by constructing the inner conductor from a number of carefully prepared sections of varying resistance.

It is essential in a wide-band dummy load to avoid any kind of discontinuity, either physically, due to a change in diameter, or electrically, due to a change in the properties of the dielectric media—the cooling liquid—filling the coaxial line. In this development it was therefore necessary to find a cooling liquid and a solid dielectric having as far as possible identical dielectric properties. Carbon tetrachloride and polyethylene were found to satisfy these conditions. Carbon tetrachloride as a coolant offers additional advantages in that its specific heat is one-fifth of that of water. This means that any dummy load using carbon tetrachloride will be five times more sensitive than a load using water as the cooling medium.

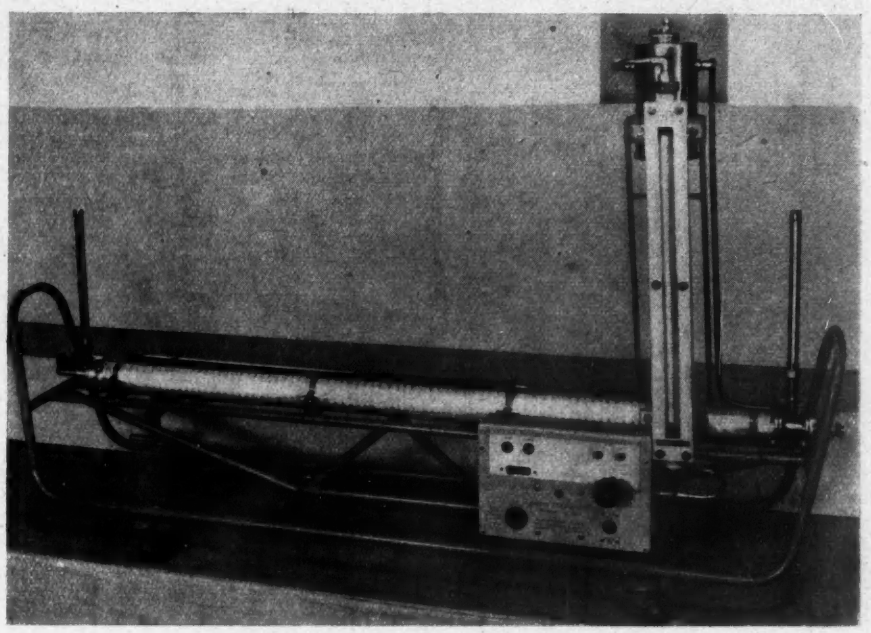


Fig. 11—Dummy Load for R.F. Power Measurements—Mullard

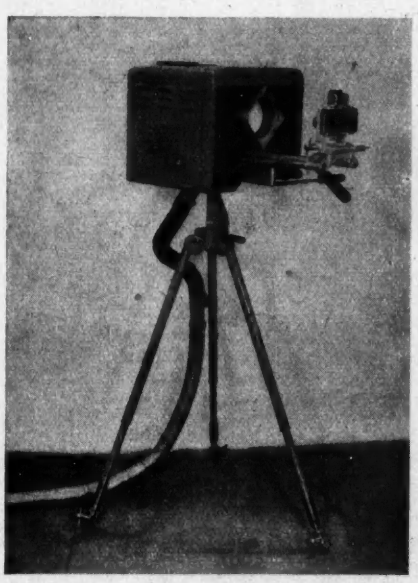


Fig. 12—Camera Unit of Image Converter —Mullard

Another Mullard exhibit showed the use of an image converter equipment as a photographic recorder of high-speed phenomena, as a stroboscope and as a chronograph. The equipment is an electro-optical instrument and consists of two units, a camera head mounted on a tripod, and a console. The camera head (Fig. 12) incorporates an image converter tube and its immediately associated components. The console houses the power supplies and the circuits for producing, routing, shaping and delaying the trigger pulses. Shutter durations of down to 1 microsecond can be obtained, with sweep speeds of up to 100mm per microsecond, corresponding to a time resolution of 2 by 10^{-9} seconds. Stroboscopic observation is possible up to 100kc/s with a shutter duration of 1 microsecond.

A paper giving a full description of the instrument was presented at the Institution of Electrical Engineers' Television Convention, April 30, 1952.†

Kelvin and Hughes, Ltd.

An ultrasonic flaw detector designed specifically for the inspection of welded pressure vessels from the inside was one of the interesting new

* "A High-Frequency Reciprocating Drill," by E. A. Neppiras, *Journal Sci. Instr.*, 30, pages 72–74, March, 1953.

† "An Industrial Instrument for the Observation of Very High-Speed Phenomena," by M. S. Richards. *Proc. I.E.E.* Vol. 99, Part IIIA, No. 20, 1952.

instruments shown by Kelvin and Hughes (Industrial), Ltd., 2, Caxton Street, London, S.W.1.

The instrument, (Fig. 13) is known as the Mark V flaw detector ; it was described in our issue of March 20, 1953 (page 424). It is a self-contained test-set housed in a sheet metal casing 17in by 9in by 5in, and weighs 28 lb. The principle of operation is the same as that of the earlier versions of Kelvin and Hughes flaw detectors, in which an ultrasonic pulse of energy is directed into the test piece by the transmitting

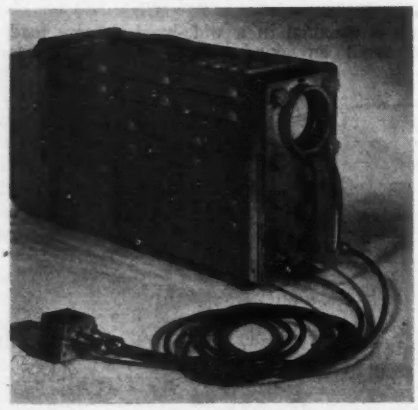


Fig. 13—Supersonic Flaw Detector—Kelvin and Hughes

crystal. This transmitted pulse is indicated by a deflection on the cathode-ray tube trace. An energy pulse reflected from the boundary of the sample is picked up by the receiving crystal and is also recorded on the c.r.t. trace. Any deflections between those corresponding to the outgoing and reflected pulses indicate the presence and give the approximate position of a flaw. The scale can be expanded so that the width of the screen represents only a small part of the total range and this facility can be variable. Scales calibrated for various metals are available for the gauge, which is operated by connecting it in parallel with the detector probe, using the duplicated co-axial outlet sockets on the instrument casing.

Selection of the frequency to suit the material under test is made from the range of 0·625, 1·5, 2·25, 2·5 and 5 Mc/s by means of a switch and filters can be plugged in to obtain intermediate values of frequency. When using vertical probes the range represented by full deflection of the time base can be varied from 2in to 12ft. With vertical probes the distances are approximately halved. The standard instrument operates from 200–250V, 50 c/s a.c. mains.

Elliott Brothers (London), Ltd.

An electronic digital computer was one of the interesting exhibits shown by Elliott Brothers (London), Ltd., Lewisham, London, S.E.13, who designed and built this equipment for the National Research Development Corporation.

As illustrated in Figs. 14 and 15 the computer is housed in a sheet steel cabinet fitted with doors back and front to give access to test points on the plug-in units and to the back of chassis wiring. The input end of the computer consists of a tape reader in which a five-hole punched tape is read photo-electrically at forty rows per second. The output of the computer is obtained from an electric typewriter at ten figures per second. As illustrated, the input tape reader, the output typewriter, and the main switches are mounted on a small trolley, which can be moved alongside the operator's desk. There is a second trolley which carries monitor and test facilities which can be used by the operator for checking the computing programmes and for servicing.

Briefly the computer itself operates with binary digits, with a specified digit rate of 333,000 per second and with thirty-two active binary digits to a word. For optimum programming the instructions are presented as a two-address code, one order per word.

The main store or memory of the machine is a magnetic wheel, rotating at a speed corresponding to the digit rate (333,000 per second) of the rest of the machine. Electronic track selection

facilities for stopping the machine at pre-designated points in a programme of operations and for feeding in numbers and orders set on switches.

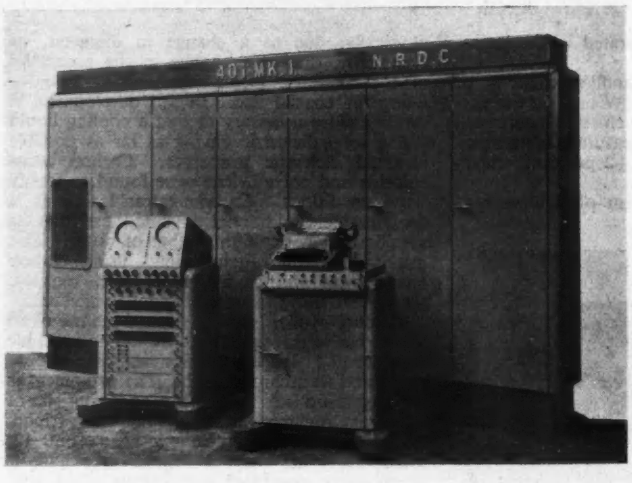
In the interests of economy in capital cost and maintenance the bulk of the electronic " circuitry " of the computer is arranged in the form of standard plug-in units or " packages." There are a large number of " packages " but each is a relatively simple assembly and servicing is correspondingly simple.

The cabinet housing the computer is 13ft long and 7ft 6in high. Air is drawn for ventilation through the base plinth and passes around the circuit compartments and through a top duct to the fan compartment inside the cabinet.

This company also exhibited a range of load cells which provide a convenient means of measuring forces from a fraction of a ton up to 200 tons. In the load cells the force to be measured is caused to stress a high-tensile steel member carrying bonded resistance wire strain gauges connected as a bridge circuit. The load-carrying member is housed in a hermetically sealed cylindrical container provided with a cable entry gland. The bridge is excited from a low voltage source and provides an out-of-balance signal of 2mV per volt input to the bridge for capacity load. The out-of-balance signal bears a linear relationship with the applied load. All cells are self-compensating for temperature variations. Calibration accuracy is stated to be within $\pm\frac{1}{4}$ per cent of full range at all points from 0·1 per cent of capacity. The current range of the cells for compressive loading includes maximum ratings of $\frac{1}{2}$ ton, $2\frac{1}{2}$, 15, 50 and 200 tons.

Metropolitan-Vickers Electrical Company, Ltd.

Vacuum pumping plant was prominent among the exhibits shown by Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, 13. The display included diffusion pumps and a range of rotary vacuum pumps. In the latter group there was a prototype (" S 10 ") single-stage pump with a displacement of 1 litre per second. The exhaust valve of this pump operates under oil, the oil tank being so arranged that the exhaust gases can be collected or discharged to atmosphere as desired. The design



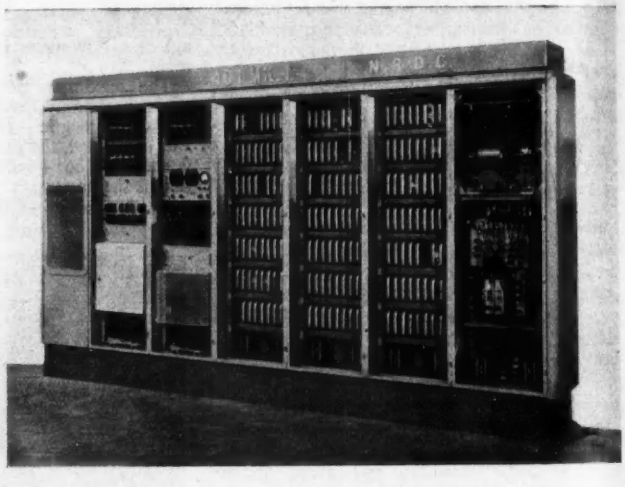


Fig. 14 and 15—Electronic Digital Computer with Monitor and Input and Output Units (left) and with Covers Removed (Right)—Elliott

used for thickness measurement or the detection of closely grouped flaws.

A variety of probes are available for use with the instrument, including the combined transceiver probe shown in our illustration. In this probe the transmitter crystal is mounted between two receiver crystals—an arrangement which gives a better performance on rough surfaces than does a single crystal. This combined probe is available as a vertical probe for generating longitudinal waves and as an angle probe for generating transverse waves.

The detector can be used for thickness measurement. For this purpose use is made of an oil-filled depth and thickness gauge, which consists of two crystals, the distance between them being

is used and the average access time to the main store of 1024 words is $6\frac{1}{2}$ milliseconds. The content of the store can be extended to 3096 words by using relay selection of additional tracks, with an average access time of 14 milliseconds.

Immediate access can be had to single word registers which take the form of plug-in magnetostrictive delay line packages. There are five such registers—two for the accumulator, one each for the multiplicand, multiplier and instruction, and one for general purposes.

Under optimum programming conditions an order is read from the main store and obeyed in 0·2 milliseconds ; multiplication takes 7 to 10 milliseconds, depending on the sign. There are

of the tank is such that oil is not displaced even when the pump is running with the inlet fully open.

This company also showed examples of its " DR " moving-coil ammeters and voltmeters. These units have a single unit die-cast movement frame so that, during assembly accurate alignment and concentricity can be achieved between the iron centre core and the moving coil system and between the core and magnet poles, thus ensuring a uniform air gap. This arrangement with its positive location of the magnet system in relation to the magnet frame results in an instrument that is capable of maintaining its initial accuracy.

Another exhibit on this stand consisted of a

differential speed indicator designed to show directly the speed difference between two rotating parts, for example, between two rolls. The equipment is actuated by two d.c. tachometer generators driven, respectively, by the shafts, whose differential speed is required. Differential speed indication is given by a ratiometer which is actuated by the difference between the generator voltages and measures the ratio between them. A compensating device maintains the accuracy of the indicator over 5 : 1 variations in the basic speed.

W. EDWARDS AND CO. (LONDON), LTD.

A gas tester for the detection of dissolved gases in light alloy melts was shown by W. Edwards and Co. (London), Ltd., Worsley Bridge Road, Lower Sydenham, London, S.E.26.

This equipment (Fig. 16) has been developed by the company in collaboration with the British Non-Ferrous Metals Research Association and is based on a technique evolved in the laboratories of that Association. The function of the new equipment is to enable the reduced pressure test to be carried out on a commercial scale by a comparatively unskilled operator.

This test depends on the fact that light alloys form tenacious oxide films which are only slightly

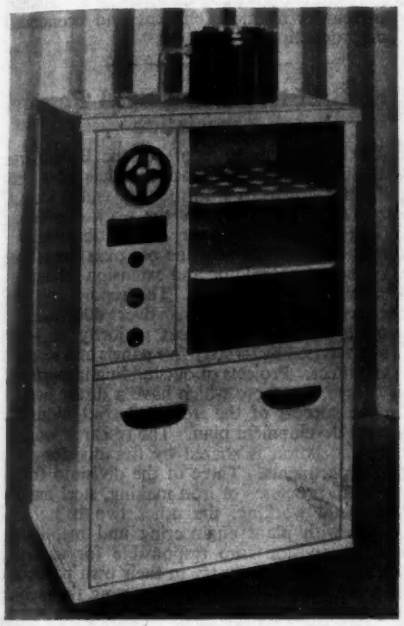


Fig. 16—Non-Ferrous Metal Tester—Edwards

permeable to gas dissolved in the metal. Moreover, modern aluminium-based casting alloys form a "pasty" mixture of solid and liquid metal during freezing from the molten state. Under these conditions, if a sample of molten metal is subject to reduced pressure (ordinarily 20mm of mercury) the gas dissolved in it cannot escape by diffusion through the metal surface during cooling. The trapped gas forms bubbles in the "pasty" interior, which inflate to a greater volume than they would occupy if the metal was under atmospheric pressures, and which tend to break explosively through the surface of the sample as it cools and solidifies.

Hence, if any aluminium-based alloy is allowed to freeze under vacuum in the Edwards test apparatus the presence of dissolved gases will be indicated either by bubbles breaking through the surface of the solidifying sample or by swelling of the whole sample.

As illustrated in Fig. 16, the apparatus consists of a rectangular-sided cabinet from the top of which there projects a vacuum-tight chamber. The cabinet houses equipment for producing, controlling and measuring the vacuum to which the test sample is exposed. The test chamber is evacuated by a "Speedivac 1S50" pump, the rate of evacuation being controlled by a main valve actuated by a hand-wheel on the front of the cabinet; this valve can also be used to isolate the chamber from the pump. The chamber pressure is measured by a barometrically compensated aneroid dial gauge on the top of the lid, which is hinged and vacuum sealed by a synthetic rubber "O" ring. The lid also carries an air-admission valve whereby the vacuum can be broken at the end of a test. The lid measures 25¼in by 16¼in and is 38¼in above floor level. Shelves are fitted in the right-hand compartment for the storage of crucibles, specimens and tools. The molten metal sample is contained in an uncoated iron crucible which is supported by a fireclay triangle in the test chamber. A hard glass window allows the test sample to be kept under observation. The motor "start" and "stop" push-buttons are in the panel below the valve hand-wheel.

Precision Drilling of Sugar Beet Seed

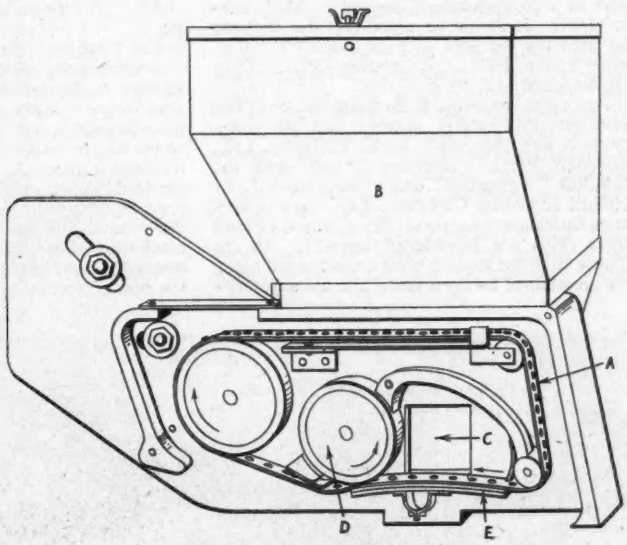
The Sugar Beet Research and Education Committee of the National Agricultural Advisory Service has recently concluded a competition designed to bring about improvements in precision seed drills. The purpose of the competition is discussed in this article, and descriptions are given of a representative selection of the machines which took part in it.

IN the years since the war considerable progress has been made in this country with the mechanical harvesting of the sugar beet crop. Machines have been developed for topping, lifting and loading sugar beet into trailers ready for immediate transport to the factory, and not only has the amount of hand labour been greatly reduced, but the whole operation of sugar beet harvesting has been speeded up. The extensive acreage of sugar beet which has now been reached in this country—about 400,000 acres annually—involves a great deal of work in thinning and hoeing the plants in the spring time. Mechanisation at this end of beet growing has not proceeded as rapidly as with harvesting, but much more attention is now being given to it. More tractor-mounted hoes are being used, and implements for thinning the plants are being devised, both of which developments are helping to reduce the amount of hand work hitherto required in the early stages of beet cultivation.

An even more important contribution, however, is being made by using "precision" or "spacer" drills for sowing the rubbed and graded beet seed that is now available to growers. It should perhaps be explained that monogerm beet seed has hitherto been the exception, two or three true seeds being present in each little husk. To use this kind of seed in a precision drill does not eliminate the plant singling process, and recent research has been devoted to methods of producing satisfactory rubbed or decorticated seed giving a high percentage of single germs. The British Sugar Corporation and the National Agricultural Advisory Service, which have been responsible for this research, now feel that satisfactory rubbed and graded seed has been evolved. Such seed placed in the ground by an efficient precision drill should result in a higher standard of single, adequately spaced, plant growth.

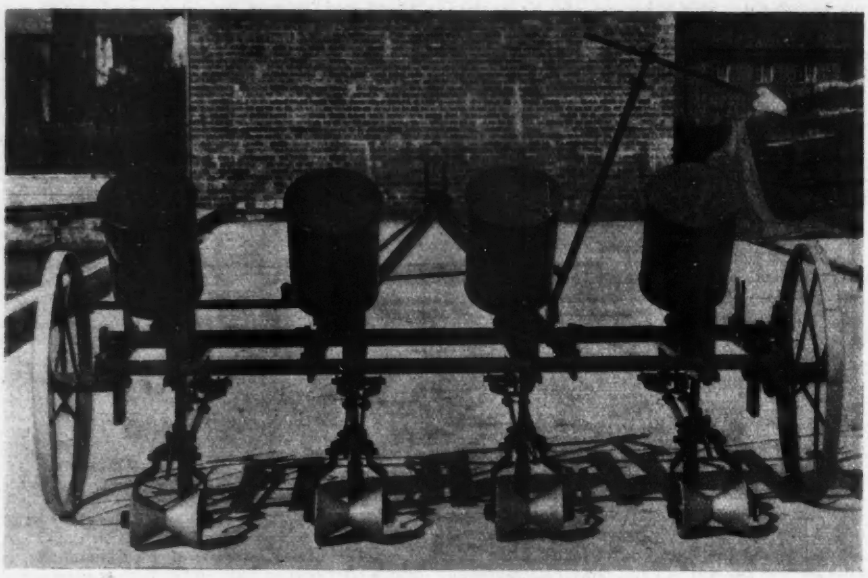
Agricultural engineers and implement makers have already put in a good deal of work on the design and production of precision drills, a number of which are now available commercially. But with the object of encouraging further the manufacture in this country of sugar beet precision drills, the Ministry of Agriculture's Sugar Beet Research and Education Committee has organised a competition, with prizes for the entrants whose drills are deemed by the judges to have shown the best performance and most efficient operation. The committee defined a precision drill as "any drill capable of depositing seed singly and separately along the row at specified distances and covering it in the same operation." This competition, which has just ended, and which we were invited to attend, was arranged in two classes, the first including tractor-drawn machines in commercial production to sow not less than four rows at once, and the second including tractor-drawn prototype machines sowing four rows or less at once. In the first class there were eight different drills which participated, and in the second class there were nine prototypes. The competitive trials were held on Mr. E. F. Harold's farm at Oulton, near Aylsham, Norfolk, and each drill was subjected to three main tests, during each of which it was required to sow two rounds in each of two fields. The judges, whose awards have not been made known at the time of going to press, were Mr. S. Newcombe-Baker, Mr. David Alston and Mr. J. H. Cock. Next week there is to be a public demonstration at Oulton of the drills which were entered for the competition, together with a display of row crop thinners, gappers and other implements for the spring mechanisation of sugar beet growing.

The majority of the drills taking part in the competition were of the class which incorporate



Arrangement of Stanhay Drill Unit

a revolving seed plate, the plate being holed or notched at intervals to permit the individual seeds to be dropped into a tube through which they fall to the ground. A departure from that method, however, has been made in the spacing drill produced by Stanhay (Ashford), Ltd., Ashford, Kent, in which the seed is placed in position by a reinforced endless rubber belt. The drill is made up of individual units, each of which is fully floating and spring loaded and can be attached to a mounted toolbar by a single stem. For the competition a five-unit assembly was used, the drive for the mechanism of each unit being taken from a spring-loaded rear wheel, which consolidates the soil after the seed has been placed. An accompanying drawing shows the arrangement of a drilling unit. The seed is fed from the hopper *B* into a small chamber *C* immediately above the endless belt *A*, which is



Twose Mounted Seed Drill

holed at intervals of 1¼in and which travels in the opposite direction to the drill. A repeller *D* constantly stirs and agitates the seed so that each hole in the belt picks up one seed; it goes partially through the belt and is conveyed along to the rear of the drill coulter in a grooved spring base *E*. The coulter has been designed to produce a small vee-shaped furrow for the accurate reception of the seed, and the point of ejection of the seed is at the end of the spring base *E*. It has therefore a drop of only about 1in from the belt to its final position in the ground. Just in front of the rear driving wheel there is a simple device attached to a drag chain which acts as a coverer before the soil is finally consolidated. It should be added that this drill can be used for the seed of root crops other than sugar beet, as belts to give spacings different from the standard 1¼in are available.

Among the four-unit drills using the seed plate principle which were entered for the competition was that made by E. V. Twose, Ltd., Lowman Works, Tiverton, Devon, and the "Milton" precision drill manufactured by Hillard Industrial Company, Ltd., State Assurance Buildings, Liverpool. Photographs of both these drills are reproduced herewith. In the Twose drill the seeding units are arranged along the crossbar of an open frame and are adjustable for row widths between 18in and 24in. The drive to the seeder mechanisms comes, as shown in the illustration, from the land wheel on the right-hand side, variations in the spacing being obtained by using different sizes of gear wheels on the main driving shaft. Each unit carries a revolving seed plate, through the holes in which the seeds drop into a rubber tube which conducts them to the ground. A rotating brush mounted above the seed plate keeps the holes clear. Depth control is independent on each drill unit, and the coverers are shaped in such a way that they mark the drilled rows so that inter-row cultivation can be carried out before the plant is visible. The Twose drill has an overall width of 8ft.

The "Milton" precision drill is made up of individual units which can be attached to the toolbar at the points determined for particular row widths. Each unit incorporates a double disc furrow opener geared to a bronze seed wheel which has accurately machined pockets in its outer surface. As each pocket moves beneath the seed hopper a seed drops into the pocket and remains there as the wheel turns on through the downspout. When the pockets in their turn reach the end of the downspout, an ejector finger meets the seed and literally kicks it down into the opened furrow. The planting depth is controlled by depth bands attached to the furrow opening discs and a spring action press wheel at the rear of each unit consolidates the soil after the seed has been placed.

"Milton" Precision Drill

Another drill which appeared in the production class in the competition was the "Taxigraine," which is made by Catchpole Engineering Company, Ltd., 19, Hatter Street, Bury St. Edmunds, Suffolk. This drill is driven by a fluted disc arrangement which obviates the need for driving chains, and the sowing rate is calibrated by the number of holes in the gunmetal seeding rotor. In designing the "Taxigraine" the makers have not overlooked the necessity for the seed to be ejected as near as possible to the ground. That point is one of the most important in precision drilling. It is not possible in this article to describe in full detail all the drills which took part in the production and prototype sections of the competition. It can be said, however, that, individually and collectively, they demonstrated the careful attention which agricultural engineering firms, both in this country and on the Continent, are now giving to a comparatively new development in mechanised agriculture. Although the competition was concerned solely with the placing of sugar beet seed, all the machines participating can, with comparatively simple adjustment, be used for the precision drilling of other root crops. The increasing use of precision drilling methods is undoubtedly contributing to more efficient and economical food production.

The British Iron and Steel Research Association

THE ninth annual report of the British Iron and Steel Research Association has now been published. It deals with the year ended December 31, 1952, and reviews the work carried out during that period in the Association's laboratories, and records also the progress made with the laboratory building and extension schemes in Sheffield and in London. The report says that the Association now has over 400 research projects in hand, the great majority of which are supervised by its sixty-five panels and research committees. Projects of outstanding importance, of course, are those which have a direct bearing on the success of the iron and steel industry's second development plan. The research work of the Association is shared by five divisions and two departments. Three of the divisions follow the main processes of iron making, steel making and metal working, the other two being concerned with plant engineering and metallurgy. All the divisions are responsible for assessing the needs of the industry in their own particular fields and for initiating and carrying through to development, research to meet those needs. The departments of physics and chemistry have the prime responsibility of studying the scientific bases of industrial operations and the application of new scientific knowledge. In addition, the report states, there is an operational research section which collates and analyses operating data on the problems under review by the divisions. The results of all the Association's research work are distributed through its information services to member-firms and, in many instances, are published generally. There are now 286 firms, employing about 85 per cent of the labour force of the iron and steel industry, which are members of the Association. The report appropriately recalls the steady growth of the Association by noting that in 1945 its industrial income was about £64,000, earning a Government grant of £32,000, and that last year the industrial income was over £312,000, which earned the maximum Government grant of £150,000. In the same period the Association's staff has grown from a small nucleus to its present total of nearly 400.

I.MECH.E. SUSSEX PANEL.—As part of the development of the work of the Southern Branch of the Institution of Mechanical Engineers, a local panel of members has been formed in Sussex under the direction of the chairman, Mr. A. J. Till and the honorary secretary, Mr. John Fox. Two visits have been arranged in the immediate future, the first being on Saturday, May 16th, to the Brighton "B" electricity generating station, and the second, on Saturday, June 20th, to the works of the Keymer Brick and Tile Company, Burgess Hill. Particulars about the Sussex panel can be obtained from Mr. John Fox, Downbarton, Grand Avenue, Hove, 3.

Continuous Shielded Arc Welding

WE have received from the British Oxygen Company, Ltd., of Bridgewater House, Cleveland Row, London, S.W.1, particulars of the manual "Argonarc" welding process and equipment now being manufactured in this country. The equipment is based on the design of the "Aircomatic" plant which has been in use in the United States for some time and has been demonstrated in various parts of this country by the British Aluminium Company, Ltd.

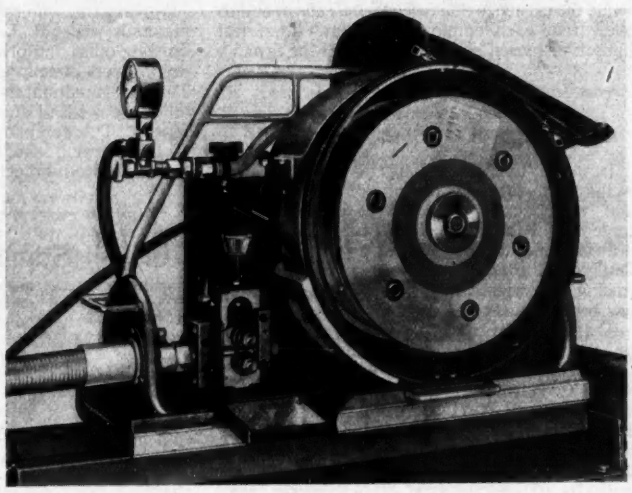
In this process, a bare wire electrode of small diameter is continuously fed through the welding gun and surrounded by a protective envelope of argon gas. With the electrode serving as the positive a direct current of relatively high current density, 50,000A per square inch minimum, is used. In the transfer of metal effected by projection across the arc, particles of electrode are deposited in the welding area. The manner of metal transfer by projection across the arc permits welding in all positions and the high current used gives a very fast rate of deposition. The makers of the equipment point out that with this process no flux is needed and the welds are of good quality, free from slag and inclusions. With multi-pass techniques there is said to be no practical thickness limit, and because of the large amount of filler metal which can be deposited comparatively few passes are needed. Thin metal down to $\frac{1}{16}$in in thickness can be welded by using smaller diameter electrode wire and lower current.

The arc is self-adjusting and the equipment includes a reel and feed motor to supply the filler wire to the torch or gun. The wire is fed to the gun through a special cable which also conducts the argon gas to provide the air-excluding shield around the arc and over the weld pool.

The automatic adjustment of the arc is governed by the burn-off rate of the wire which is fed at a constant speed through the gun. If the operator tends to draw the gun away from the work, so lengthening the arc, the burn-off rate is reduced, the wire is fed to the work and the arc is shortened. If the gun is brought too close to the work the reverse happens and thus a reasonable latitude is given to the operator without any adverse effect on the weld.

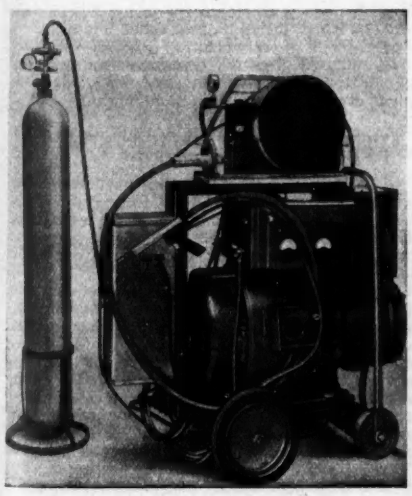
The "Argonarc" welding equipment, which can be seen in the accompanying illustration, consists essentially of the usual d.c. generator and contactor mounted on a wheeled trolley with the wire feed unit above. Connections are provided for the cylinder of argon gas which can be arranged at any convenient position near the set.

The wire feed unit shown in one of the illustrations incorporates a reel holder from which the wire is drawn off by a pair of motor-driven rollers at a preset speed. Tensioning of the wire is effected by adjustment of a knurled wheel on the reel mandrel. The upper idler of the feed can be adjusted to give the required grip on the wire and the speed of the roller drive motor can be adjusted.



Welding Wire Feed Unit

Welding Gun



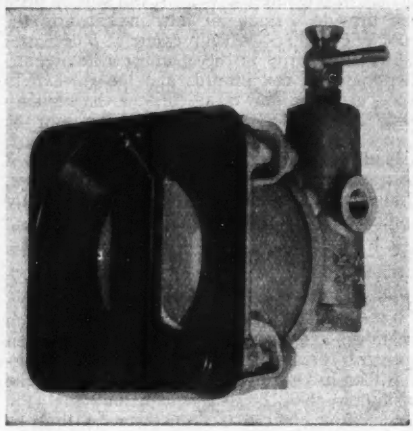
"Argonarc" Welding Set

At the start of welding the electrode or filler wire is first brought forward so that it projects about $\frac{1}{4}$in beyond the nozzle of the gun. Then, when the trigger of the gun is pressed the welding circuit is switched on and the argon starts to flow. On the tip of the wire then being brought down to the face of the joint the arc is struck. At this stage a relay starts the wire feed motor and the wire is fed forwards and the burn-off action continues.

The use of this process is not confined to light alloys, and it can also be employed on stainless steel and copper base alloys. We are informed that certain kinds of welds between dissimilar metals, such as copper to steel, can also be successfully effected employing an aluminium bronze wire as the filler material.

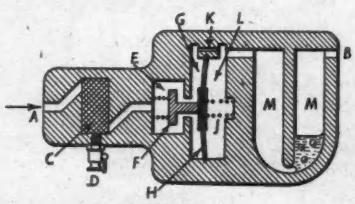
Instrument for Controlling Compressed Air Supplies

AN instrument which combines the duties of a bubbler chamber, pressure reducing valve and needle valve, known under the trade name of "Pneumerstat," has been developed by Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester, in collaboration with the Dyestuffs Division of Imperial Chemical Industries, Ltd., for which company the instrument is now in quantity production. This instrument gives a constant flow and can be used in connection with open or closed vessels under pressure or vacuum. It is being used to control the supply of compressed air to instruments such as manometers used for the indication of content, level or pressure. It has also been used successfully for the accurate regulation of a slow feed of water for laboratory tests and in the equipment for the continuous sampling of gas for analysis of shed atmosphere and absorption tower outlets, &c.



Air Control Instrument

One of the new instruments can be seen in the photograph reproduced on this page and its operation can be followed with reference to the diagram above. When the instrument is in operation the pressure of the air supply entering at *A* should always be greater than the pressure or head being measured at *B*. The ingoing air is cleaned by a filter *C*, from which any accumulation of dirt or moisture can be blown out by opening of the drain valve *D*.



Arrangement of Air Control Instrument

The filtered air passes into an upstream chamber *E* and on through a spring-loaded valve *F* to a primary diaphragm chamber *G*. The pressure of air on the diaphragm *H* flexes it in opposition to the force exerted by the main spring *J* on the other side of the diaphragm. Flexing of the diaphragm enables the spring of the valve *F* to press it down on to its seating and thus shut off the air supply to the primary diaphragm chamber. The air in this chamber flows through a capillary *K* into the secondary diaphragm chamber *L*, where its pressure on the opposite side of the diaphragm assists the main spring to

press the diaphragm back and move the valve *F* off its seat.

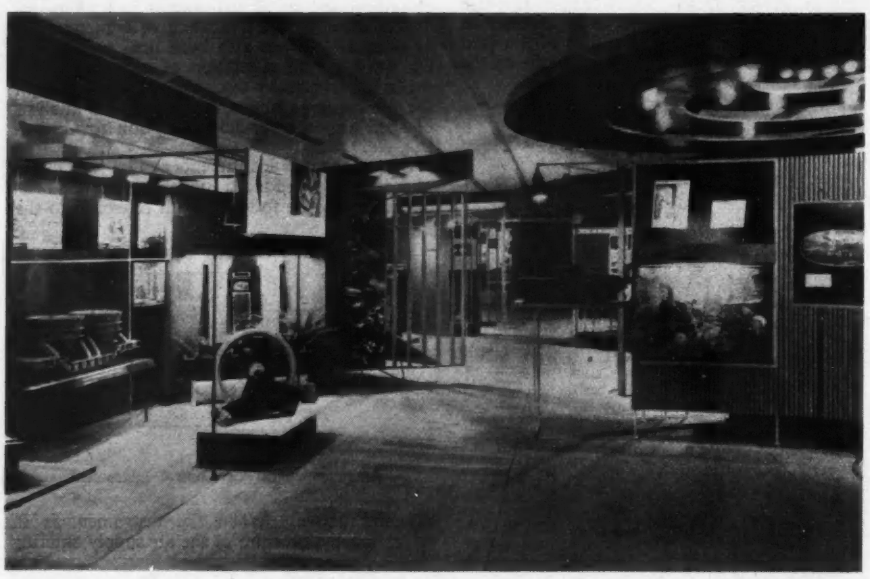
Considering now the measuring of pressure at *B*, the air pressure in the chamber *L* will build up until it is equal to that being measured, when the pressures on each side of the diaphragm will be equal. This balancing of pressures will allow the valve *F* to move to its open position. In this way, due to the arrangement of springs, there is always a small flow of air from the upstream chamber *E* to the chamber *L*—via the valve *F*, chamber *G* and capillary *K*—irrespective of the pressure at *B*. The air passes from the chamber *L* to the air outlet through the bubbler chamber *M*. This bubbler chamber is filled with a special liquid, and is so designed that the air must pass through the liquid and give indication of flow through the instrument.

It will be appreciated that when the pressure at *B* increases it will cause a pressure rise in the chamber *L* and, through the capillary, the chamber *G*, the rate of rise in the second chamber being controlled by the capillary. After such a change in pressure the valve *F* will still be open and provide a small air flow indicated in the bubbler chamber. When pressure at *B* decreases the pressure drop in the chamber *L* allows the diaphragm to flex inwards and the valve *F* to close, until the flow of air through the capillary from the chamber *G* restores the balance in the diaphragm chambers.

Under each of these operating conditions a flow is always indicated in the bubbler chamber, although its rate increases or decreases slightly in relation to the pressure at *B*.

A Works Exhibition

At the Thorncliffe works of Newton Chambers and Co., Ltd., an exhibition has been opened to present "A New Industrial Relationship Plan in Operation." It is intended that the exhibition shall be permanent, but that the presentation shall vary from time to time as necessary. As will be seen from our picture, the exhibition is arranged upon the "display" lines that have been so much developed since the war and were made generally familiar by certain parts of the South Bank Festival Exhibition. The activities of the firm are shown by carefully designed panels containing wording, photographs, drawings, documents, &c., by models and full-scale products placed in relation to the panels, and by the use of special viewing devices. Of course, the exhibition refers to the firm's products. But it is not an exhibition of products. It is intended to show how people live and work at Thorncliffe and what is the industrial atmosphere in the works. It opens with references to the historical background of the firm, going back to 1793, and traces its development. It illustrates what is being produced now and how it is being produced, and it ends by revealing something about Thorncliffe people. In particular, it reveals how much care is taken in the training of youth and what fine welfare, educational and cultural services have been built up. It stresses how facilities for recreation and for study of various subjects have been fostered as part of the activities of the Thorncliffe community, and emphasises how the interest and personal identification of the activity of each employee in and with the activities of the firm as a whole has been encouraged. It is made clear that the workpeople are recognised and encouraged as craftsmen in partnership with each other. In fact, its purpose is to illustrate the good relations that exist between workers and management, to demonstrate the existence of a true *esprit de corps*, and to show that each employee can, and does, feel himself or herself an essential part of the firm.



A Works Exhibition

Centenary of Hall Harding, Ltd.

In April this year Hall Harding, Ltd., the well-known firm of drawing-office equipment and materials manufacturers, celebrates the centenary of the first recorded transaction in the drawing-office trade by a member of the Harding family and to mark the occasion a brochure tracing the origin and growth of the company has been published.

The firm originated from a business founded by the brothers Samuel Smith and Charles Davis Harding, who traded under the title of S. and C. Harding. The first recorded sale was made on April 30, 1853, from premises at 11, Thavies Inn, Holborn, London, E.C.1. At that time the firm was particularly concerned with the importing and distribution of tracing papers made by its establishment at Courbevoie, near Paris.

In 1866 the brothers acquired the business of one Edward Ruff, a map and paper mounter and tracing paper manufacturer, and moved into his premises at Hind Court, London, E.C.4.

The centenary brochure traces the growth of the business and records that when Paul, the son of Samuel, joined his father and uncle, the firm's name was changed to S, C. and P. Harding, Ltd.—a name it retained up till 1943, when it amalgamated with B. J. Hall and Co., Ltd. In the years that followed the purchase of Edward Ruff's business, the company made rapid growth and many new products were introduced. In 1904 a larger and more up-to-date works and offices were established at Camberwell. Many of the most important developments in the firm's progress and its increasing prosperity are attributed to the late Samuel Alfred Harding, a son of the original Charles Harding and father of the present chairman and managing director.

The firm of B. J. Hall and Co., Ltd., was started by Benjamin James Hall in 1896, and expanded rapidly on account of the inventive ability of its founder and the acumen of Mr. A. P. Webster, who became its managing director in 1917. With the growth of the company an engineering and woodworking factory was built at Acton and branches for direct sales opened in various parts of the country. In 1932 new offices were opened in Dacre Street, Westminster, and this building is now the head office of the amalgamated company, Hall Harding, Ltd.

Up to the time of the amalgamation S. C. and P. Harding, Ltd., was mainly concerned with supplying the wholesale and export trade with materials whilst B. J. Hall and Co., Ltd., made drawing-office and print-room equipment, selling its products directly to engineers and architects. The amalgamation, therefore, made it possible to fill all the needs of draughtsmen from one organisation. The company now has three factories at Camberwell, one at Acton, in London, as well as fourteen branches.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London S.W.1.

OIL CIRCUIT-BREAKERS FOR A.C. SYSTEMS

No. 116 : 1952. Price 15s. The new edition of B.S. 116 applies to oil circuit-breakers only. The relevant portions of Part I of the 1937 edition continue to apply to oil switches and oil isolating switches until they are superseded by new British Standards now in course of preparation. It applies to oil circuit-breakers for single-phase and three-phase a.c. systems, except those oil circuit-breakers up to 660V, intended for use in electrically remote parts of a system, such circuit-breakers being covered by B.S. 936. Service conditions are defined and standard ratings are listed for rated service voltages up to 275kV. Requirements are specified for construction, test and performance. Appendices cover information to be given with inquiries, orders and tenders, calculation of fault currents, selection and maintenance of circuit-breakers, details of test methods, and information to be included in test reports.

OIL BURNING EQUIPMENT

No. 799 : 1953. Price 10s. When this specification was originally published in 1938 its subject matter was then confined to fully automatic oil-burning equipment for central heating and hot water supply suitable for fuel oils conforming to Grades A and B of B.S. 742, "Fuel Oils for Burners." The standard has now been extended to include semi-automatic and hand-controlled equipment suitable for petroleum oils, Grades A, B and G of B.S. 742 and coal tar liquid fuels to B.S. 1469.

The standard applies to oil-burning equipment for boilers, heaters, furnaces, ovens and other similar plant, but it is not intended to apply to marine and mobile installations. Oil-burning plant of each of the main types is employed for many diverse purposes and it has, therefore, been found impossible to cover all details of every plant.

The standard gives full descriptions of items of equipment required (without sizes), including particulars of storage tanks, fittings, oil pipelines, &c.

COPPER FOR ELECTRICAL PURPOSES. SHEET AND STRIP

No. 1432 : 1953. Price 4s. This publication is a revised edition of B.S. 1432 : "Copper for Electrical purposes : Sheet and Strip," which is one of a series of standards for copper for electrical purposes. The others in the series are : B.S. 1433, "Copper for Electrical Purposes : Bar and Rod"; B.S. 1434, "Copper for Electrical Purposes : Commutator Bars." B.S. 1432 includes provisions for annealed, half-hard and hard conditions, two diagrams of recommended sizes of sheet and strip for transformer windings, and the windings of rotating electrical machinery, respectively, from which designers are encouraged to choose their requirements. It is hoped in this way that there will in time be a considerable reduction of the number of sizes demanded. An additional provision is included in this standard whereby the purchaser can, by special arrangement, specify that sheet or strip shall be made from oxygen-free high-conductivity copper complying with B.S. 1861 (recently published).

The Institution of Naval Architects

ANNUAL SPRING MEETING

No. IV—(*Continued from page 560, April 17th*)

ON Friday morning, March 27th, the meeting opened with the reading of a paper entitled :

WATER FORCES ON SUBMERGED BODIES IN MOTION

By W. C. S. WIGLEY, M.A.

SUMMARY

This paper states the present position of our knowledge of possible methods of calculating the forces and moments acting on a body in motion in a fluid in the neighbourhood of a free surface. The general problem is discussed and an analysis given of the forces and moments to be expected from the various physical causes. It is shown that a body with a horizontal axis of symmetry, moving steadily parallel to that axis, allows of calculation of all forces and moments except the frictional resistance. The method of solving this problem mathematically is described with a clear statement of the assumptions which are made, but no attempt is made to reproduce the actual mathematical expression. The numerical results for calculations made for a fine spheroid covering the complete range of speed and depths of immersion of its axis down to a depth equal to the length are given in three tabular statements which record the coefficients of wave resistance, vertical force and moment respectively. These results are also shown graphically with the coefficients plotted to a base Froude Number N. The possibility of applying these methods to other methods of motion is discussed, such as a body moving along an axis of symmetry which is not horizontal or moving at a small angle to its axis of symmetry.

DISCUSSION

Sir Thomas H. Havelock : I am glad Mr. Wigley has published this record of some of his work on submerged bodies in motion ; it is valuable to have a clear statement of the problem, together with such a comprehensive set of calculated results. I suggest that some references to general theory might be useful to the reader ; for instance, a paper by Kotchin (Moscow Conference on Wave Resistance, 1937) and a recent general study by Cummins (T.M.B. Report, No. 780, Washington, 1952).

Not every solid of revolution can be represented by a line distribution, either exactly or approximately. For the general ellipsoid the known distribution is on a certain plane, and I think the corresponding forces could be calculated without much more difficulty.

With the method used for approximating to the velocity potential, first order terms for the horizontal and vertical forces are given entirely by the first approximation, but first order terms for the moment are contributed also by the second approximation to the velocity potential. I therefore criticise the wording at the end of section 2 of the paper, " the second approximation to the moment." The term referred to is an essential part of the first approximation to the moment, although it happens to come from the second approximation to the velocity potential on account of the method used in obtaining that function. One would like to see real second approximations both for the forces and for the moment ; but there are many important problems which are still lacking even a first approximation.

Dr. R. S. Guilloton (France) : As Mr. Wigley's work is very general, I wished to see how the problem would appear in a particular case and I have therefore examined a spheroid. The functions used are those published in my paper, " Potential Theory of Wave Resistance . . ." (S.N.A.M.E., New York, 1951) ; these are divided into oscillating functions 2A, which give the resistance, and non-oscillating functions $S+F$, which, added to $2A$, give the pressure in the fluid.

Although Mr. Wigley's calculations are more rigorous than mine, their values of the coefficient of wave resistance agree closely. The calculations were repeated with the body divided by three water lines. The surface wave was calculated by this means and the resistance was calculated from the surface wave. The resistance thus found differed by only 6 per cent from that calculated directly. The resistance was then calculated with the spheroid in its position of natural trim and the same value was found as in the horizontal position.

There is a difference of 11 per cent in the vertical force coefficients calculated by Mr. Wigley and myself, but this is due to the fact that Mr. Wigley's calculations are for a fine spheroid. My value of coefficient of moment is about 3·3 times that of Mr. Wigley, owing to the fact that the methods of approximation are not identical.

In the case of the general ellipsoid the terms β^2 in Tables I, II and III (coefficients of wave resistance, vertical force and moment for the submerged spheroid) may be replaced by $\beta\beta^1$, where β^1 is the ratio draught/length and β remains the ratio of beam/length.

Professor Kenneth S. M. Davidson (U.S.A.) : In America we are interested in this problem and what has impressed us is that, without some sort of theoretical guidance, it becomes extremely difficult to produce results by experiment alone. The shape of the curves in Figs. 1–3 of the paper makes it evident that if you get data which correspond to those curves without some reason to suppose they must be right, you are very much inclined to suppose they may be wrong. It does seem a pity that we are not given experimental results with the theory ; I am sure that it would add to the value of the work if we had both in the one paper.

Sir Geoffrey Taylor : One of the suggestions made in the paper is that we may be able to apply these methods to a thing which has different dimensions vertically and horizontally. It seems to me that integrating all over a flat surface would be very difficult ; but is it possible, instead of having a line of sources, to have only a line source with associated quadruples ? You will then have a surface which is different in width and height and it may make your integrals easier. Obviously you would have the same difficulties multiplied many times ; at the same time, it might be easier than trying to integrate over the surface.

Mr. John Hall : I think the value of the paper would be increased if we had more indication of the actual mathematics involved. Mr. Wigley goes very easily from the second to the third approximation, but for the rest of us I do not think it is quite so easy.

I would like him to amplify the statement that this third approximation is necessary to find the moment. He states that the value of the potential suffices for the calculation of the forces, though not of the moment. That implies that this is only a matter of approximation. A little later he says you get a contribution to the moment from this second approximation and implies that as a matter of principle you must have the third approximation.

Mr. G. H. Room : Similar calculations, of moments, have been carried out by Dr. Hartley Pond, working at the Taylor Model Basin in the United States, and he has obtained figures for the Rankine ovoid, instead of a spheroid, which have close agreement with figures worked out by Mr. Wigley for the same body. The special functions which Mr. Wigley mentions, which have led to better approximation to the actual figures in the table, have since been worked out more accurately, but the variation is quite small.

These functions can be used for other bodies, using the integrals in the mathematical theory, and they are being used now to provide similar calculations for less symmetrical bodies, still bodies of revolution, but unsymmetrical fore and aft.

Mr. J. R. Shearer : Mr. Wigley has extended the field from the single force, i.e. the resistance, to the consideration of all the forces and moments. One is rather tempted to extend the work further to the calculation of trimming moment on the surface of the body ; I imagine that when that problem is brought in the difficulties of attaining approximation to the condition of free surface would be very much more difficult.

A practical use of this kind of work would be in connection with the consideration of the stability of a submarine body. In this work the body will be constrained to move along its axis. If the body were free, I suppose it would be moved by the forces and moments which Mr. Wigley has calculated. In the only experience we have had at the N.P.L. of towing submarine bodies of revolution we had great difficulty in towing near the surface, particularly when wind was appreciable and the bodies became unstable.

Mr. L. Woollard (Vice-President) : It appears from the diagrams that the forces and moments vary as the fourth power of the beam. That point is not explicitly stated. Will Mr. Wigley confirm it or otherwise ?

Secondly, a previous speaker has said that he would like to see some of the mathematical formulæ on which these calculations were based. They are given in the papers by Sir Thomas Havelock, which are cited in this paper. Nevertheless, I believe that the last two are easily accessible, and I suggest that if Mr. Wigley could add an appendix containing a formula or two it would be of help.

The second paper presented on Friday morning, March 27th, was :

A SKIN FRICTION DETERMINATION USING WALL-SIDED MODELS OF GREAT DRAUGHT

By R. T. SHIELLS, B.Sc.

SUMMARY

Two fundamental assumptions made by Froude can be stated as follows : (*a*) Skin friction and wave resistance are separate entities which do not mutually affect each other ; (*b*) skin resistance could only be determined by plank experiments, and residuary resistance (chiefly wave resistance) could only be determined by subtracting the skin resistance from the total resistance.

The writer has of necessity retained assumption (*a*), but has reversed assumption (*b*). An attempt has been made to produce a friction line—that is to say, a line corresponding to zero beam, by subtracting the calculated wave resistance from the total resistance.

The apparatus used was a specially designed gravity dynamometer, based on the simple form described by the writer in a previous paper (*Trans. I.N.A.*, 1948).

A line free from edge effect under fairly full beam conditions has been obtained by tests on a family of three models, all of 15in draught, and having beams 1½in, 2¼in and 3in respectively. Care was taken to ensure turbulent flow.

Finally the wave profiles of the models were recorded photographically and compared with the calculated profiles.

DISCUSSION

Dr. R. S. Guilloton (France) : The values for the frictional resistance of a plank found by Mr. Shiells will attract the attention of specialists because of the care taken to obtain

the results. Those interested in the theoretical resistance of forms will have an opportunity to reflect on the differences between the calculated waves and resistances for models of such small beam.

The first idea which would come to one's mind, when wishing to extrapolate the results of the models, tested to find the characteristics of the curve of frictional resistance for the plank, seems to be the consideration, without any further hypothesis, of the development in series of the resistances as functions of the beam of the models for each speed. The application of method "A" shows that in this development the only important terms are the constant term which is the resistance of the plank, and the term proportional to the square of the beams. That this is so, and that also the term proportional to the square of the beam is clearly different from the resistance in a perfect fluid, appears to be important, although the physical interpretation is not at once evident.

Mr. W. C. S. Wigley : I am interested in this paper rather from the point of view of the comparison of the experimental with the calculated wave resistances than with the general problem of skin friction. I note from Fig. 6 of the paper (comparing calculated and experimental wave resistances) that the oscillations in the wave resistances as found experimentally are less than those in the calculated curves, and the difference is rather more for the smaller model than it would be for the larger model. Fig. 12 (comparing calculated and experimental profiles at 4·53ft per second) also shows more difference amidships in comparison with the larger models. The two things together mean that the measured viscosity on the comparatively short waves is greater than for the standard size models of 16ft to 20ft, and that has created difficulty in experiments with small models until some way is found to correct for the effect of viscosity on wave resistance. There is evidence that the effect of viscosity on the wave resistance is larger for the 4ft model than a 30ft model, and we do not know how much larger it is for the 4ft model than for the big ship, and to find out it would be necessary to measure accurately wave profiles on full-size ships.

Professor Sir Thomas Havelock : This paper is welcome as a new attack on what is becoming a rather well-worn topic, and it should give rise to fresh thought upon this subject. The novel points lie in methods A and B for defining a new friction line. I find method A more precise from the theoretical point of view in that the assumptions are clear and definite, the wave resistance proportional to the square of the beam, the skin friction the same as for the equivalent plane, and no complications. In method B I find the assumptions more difficult to follow, but the actual results are very interesting and intriguing.

It is clear from the paper what is meant by the calculated wave resistance, but it may be as well to say explicitly that this is the wave resistance calculated for motion in a frictionless liquid (without any so-called viscosity correction). When this theoretical wave resistance is subtracted from the measured total resistance in an actual liquid I can only call what is left the remainder, whatever factors it may be supposed to include. It is implicit in method B that the effect of viscosity on wave resistance is practically limited to diminishing the oscillations in the curve ; though this is the main effect, I think it also alters the mean trend of the curve. From this point of view I find the argument rather doubtful for locating the points at which the effect of viscosity may be taken as nil. I am fully aware of the difficulties in which one may be involved in trying to define wave resistance in a viscous liquid ; but these difficulties are inherent in the process of assuming that the total resistance can be split up into additive terms. In fact our definitions are to a large extent conventions devised for the purpose of making the problem tractable.

I am all in favour of trying out a new idea, even if one cannot put down a completely logical basis for it. In this case the assumptions are sufficiently reasonable and the result is certainly intriguing. Mr. Shiells obtains a new friction line, shown in relation to others in his Fig. 7, which seems to have a right to existence alongside the other lines.

Sir Geoffrey Taylor : Has the author ever thought of the possibility of trying to remove the boundary layer by suction ? That method is used a lot, in aeronautics, and it seems possible that it would get nearer to the theoretical wave resistance.

With regard to the cord used for pulling the model, when you use a string around a wheel the string stretches slightly and it stretches different amounts around the wheel. There is a theory of the way in which the slip occurs and I wondered how far that sort of consideration came into this work.

Dr. G. Hughes : I am tremendously interested in the subject of friction and I have made a certain amount of analysis of my own. I feel that Mr. Shiells has got very near to the correct answer for the friction of the surface of no thickness, but would make one or two suggestions for modifications of his analysis.

In the appendix dealing with sand strip resistance, his Fig. 9 suggests that the mean difference between the two curves is 5·0 units. The curves appear to be fairly parallel, but measurement shows there is a variation ; there is a difference between the two curves of 4·4 units in the speed range from 3·0 to 3·5 feet per second, and then the difference increases to a maximum difference of 5·7 units at about 4·3ft per second. I suggest that the true difference between the curves is 4·4 units and not 5·0.

We have done some work on sand strip and other resistance at the N.P.L. and, comparing the results in the paper with ours, the drag coefficient for the sand strip does seem on the high side even taking 4·4 units, but that may be due to the sand strip tending to widen out the wake belt so that there is a graduated resistance which will not be present on the bare model. I cannot accept the suggestion in Fig. 8 of the paper that with the bare model the full turbulence stimulation was reached at a speed of 4·5ft per second. At the N.P.L. a great deal of work has been done on turbulence stimulation with models of narrow beam and I have yet to find that full stimulation has been achieved at so low a speed ; we have to go to much higher speed to get full stimulation at the forward end. That agrees with my suggestion that 4·4 units or even less is a true indication of the sand strip resistance.

As to the analysis of the results, I ask whether there is any evidence that you can expect to get points in which the viscosity effect is nil. In Mr. Wigley's work I could not find any evidence which makes that acceptable. We should apply the form drag correction. Mr. Shiells mentions that he has not taken account of it, but it is a serious matter because these models have quite a fair beam, especially the larger ones. According to other work, we should expect the form drag to vary, not as the square of the beam, but rather linearly with the beam. So that if the form drag contains partly a pressure effect and partly a variation linearly with the beam, that should be eliminated first, before the wave resistance is eliminated. That can be done, I suggest, by introducing a factor into the formula.

Mr. H. L. Dove : To be able to carry out experiments like this without the facilities of the experimental tank behind you is really remarkable. Our lack of knowledge of the effects of form on skin friction and of viscosity on wave making suggests that to use the mathematical formulæ for wave making resistance is a little premature. It is borne out by the curves in Fig. 12 of the paper showing the wave profile as measured and as calculated. The differences are apparently quite large and a similar error must therefore be found in the calculated resistance.

The curves in Fig. 5, obtained by subtracting wave making resistance from total resistance (the middle set and the lowest set) lie together. This seems strange, as it would be expected that the curves would be separated by form drag, i.e. the increased frictional drag due to the increased velocities on the surface. The difference in the magnitude of the resistance constants in going from the narrowest to the largest beam would be expected to be approximately 5 per cent as deduced from ship model experiments at the correct M values, and tests on symmetric aerofoils in wind tunnels suggest the difference would be approximately 6 per cent based on the thickness to chord ratio. There is therefore reason for thinking that an appreciable difference should be indicated.

Mr. W. Muckle : Mr. Shiells' Fig. 5 is essentially a resistance coefficient diagram to a base of Reynolds number. The point that intrigues me is why in Fig. 5 the resistance should be a straight line and in Fig. 7 it becomes curved. The difference is probably very slight, but I should like Mr. Shiells' opinion on the matter. I wonder whether the wave profiles which appear to be quite appreciable, have any influence on the actual wetted surface area and whether the author has taken that into account in calculating his coefficient. Fig. 6 shows a comparison of experimental and calculated wave making resistances. Presumably the experimental wave making resistance has been determined by deducting the friction resistance. Has the author used method A in making the calculation of frictional resistance ?

Professor E. V. Telfer : Suppose we take the difference between the unstimulated and the stimulated resistance as a function of the amount of stimulation. At zero stimulation we have no result, but on first stimulation there is a very rapid increase in resistance ; then we go on to still more stimulation. To get to the true turbulent condition you have merely to come back to zero in your stimulator effect and find out that particular correction. As far as I can see, that must be the correct way to do it, but until we clear up this mechanism we shall all be at sixes and sevens in our understanding of low-speed friction resistance.

I was interested in Mr. Shiells' use of the work of Sir Thomas Havelock and Mr. Wigley, that the wave making resistance varies as the square of the beam. That is very attractive, and ship designers have attempted to use it for a long time. If we investigated quite normal or even quite fine beams, with beam as the base plotted against resistance over beam squared, we should get a series of oscillations in the diagram, showing that some are good beams and some are bad. Unfortunately, we cannot make use of that ; it we could, a new line of model experimenting would be open to the naval architect.

(*To be continued*)

Work of the U.S. Atomic Energy Commission

(By Our American Correspondent)

THE first decade of atomic energy development by the Government of the United States ended in 1952, and the thirteenth biannual report to Congress of the U.S. Atomic Energy Commission reviews several important research and development schemes which began earlier in this decade. To meet the increased military requirements for national defence, Congress, in July, 1952, authorised the largest addition yet made to the plant used for the production of fissionable materials and weapons. Construction of these new works was started promptly, and when it reaches completion, the American capital investment in atomic energy projects will amount to about 7500 million dollars.

Raw Materials

The last half of 1952 saw initial production from two important new sources of uranium: the gold ores of South Africa and the phosphate rock of Florida. The South African Government and mining industry, in co-operation with the United States and the United Kingdom, have now laid the groundwork for an entirely new industry which recovers uranium as a by-product from the gold ores of the Witwatersrand. On October 8, 1952, the Prime Minister of the Union of South Africa officiated at ceremonies which officially set into operation the first uranium recovery plant for treatment of tailings from the Rand gold mines. Additional plants under construction in the Transvaal are now in various stages of completion. Plans are being made for the erection of several more uranium plants, some of which will be in the Orange Free State.

The Commission's domestic exploration programme, consisting principally of geological investigations, airborne radiometric surveys and exploratory drilling, has expanded to meet the needs of the increased production programme. The exploration work is carried out by the geological staff of the A.E.C., the U.S. Geological Survey, the U.S. Bureau of Mines, and by private contractors. Important aspects of the current exploration effort are the development of new and improved techniques and instruments, geological guides, and the dissemination of information to encourage the search for uranium by mining companies and prospectors. Although the Colorado Plateau remains the most favourable area for the discovery of new domestic ore bodies, field reconnaissance has revealed other areas of potential uranium ore production. Principal among them is the area adjacent to, and south-east of, the Black Hills of South Dakota, where sufficient ore has been found and produced to warrant the establishment of an ore-buying depot. The ore occurrences in this area are similar to those of the Colorado Plateau. In nearby areas in Wyoming, investigations are disclosing minor sources of uranium ore.

The Commission continues to sponsor research in the field of raw materials directed toward (1) the development of processes for treating the various types of ore encountered on the Colorado Plateau and in other areas; (2) the improvement of processes in use at the mills on the Colorado Plateau; (3) the development of economic and efficient means of extracting uranium from low-grade sources, and (4) the development of processes for treating ores from foreign sources. In addition, fundamental studies continued in an effort to find more efficient and more economical processes which might be applied to all uranium ores.

Production

The production of fissionable materials continued as scheduled during the last six months of 1952. Following the Presidential approval in July of a supplemental appropriation for the expansion of atomic energy production capacity, work got under way on a new uranium 235 plant in Ohio, on additions to the uranium 235 plants at Oak Ridge, Tennessee, and at Paducah, Kentucky, and on additional plutonium capacity at Hanford, Washington. The major new facility in the expansion programme is a gaseous diffusion plant being constructed on the Scioto River in Pike County, Ohio, about 22 miles north of Portsmouth. The selection was made after considering several alternate sites in the Ohio River Valley, where ample supplies of water and electrical power are available.

In October last, the Commission contracted with the Ohio Valley Electric Corporation, a group of fifteen private power companies, to supply the 1800MW of electric power required for the operation of the Portsmouth gaseous diffusion plant. The corporation will build and operate two steam power stations, one to be situated at Gallipolis, Ohio, and the other at Madison, Indiana. The two power stations will have a combined installed capacity of 2200MW. Of the additional power required for the expansion at Paducah, 235MW will be supplied by Electric Energy, Incorporated, a group of five private power companies, and 705MW by the Tennessee Valley Authority. T.V.A., which will also provide the 950MW for the expansion at Oak Ridge, will add capacity to its system at various steam power stations to meet these demands.

Military Applications

The production of atomic weapons continued at the rate authorised by the President for the calendar year 1952. Research continued to be directed at the improvement of weapon models and the development of new weapons to meet the requirements of the armed Forces. In October, at the Aberdeen Proving Ground, Maryland, the U.S. Army publicly demonstrated its 280mm cannon which is capable of firing an atomic projectile. The projectile was designed and developed by joint efforts of the U.S. Army and the Los Alamos Scientific Laboratory and Sandia Laboratory of the A.E.C. in New Mexico.

Additional experimental detonations were completed during November at the Eniwetok Atoll in the Pacific Ocean. This undertaking, known as Operation IVY, was conducted by Joint Task Force 132, which was composed of personnel of the A.E.C. and the U.S. Army, Navy and Air Force. The following abstract is from the announcement of the completion of the IVY test series, issued November 16, 1952:—

"Joint Task Force 132, operating for the Department of Defence and the United States Atomic Energy Commission, has concluded the third series of weapons development tests at Eniwetok Atoll in the Marshall Islands. Like the Greenhouse series, 1951, it was designed to further the development of various types of weapons. In furtherance of the President's announcement of January 31, 1950, the test programme included experiments contributing to thermonuclear weapons research. Scientific executives for the tests have expressed satisfaction with the results. . . ."

Reactor Development

Progress was made during the last six months in the development of nuclear reactors for power generation, production of fissionable materials and research. The new materials testing reactor, which was completed last spring, at the National Reactor Testing Station in Idaho, was put into service in August by the operating contractor, the Phillips Petroleum Company. The reactor is now providing irradiation for certain tests being conducted in conjunction with the development of various types of reactors by A.E.C. laboratories and contractors.

The operation of the experimental breeder reactor, also situated at the Idaho Testing Station, to gather data on the possibility of "breeding," was continued by the University of Chicago through the Argonne National Laboratory. The knowledge and experience being gained in the operation of this first small, experimental reactor power plant system will be applicable eventually to larger units. Since the homogeneous reactor at the Oak Ridge National Laboratory reached "criticality" last spring, it has been operated at low power in experiments to determine nuclear characteristics. Inasmuch as this is the first circulating fuel reactor of the A.E.C., this work is considered to be especially important.

In July, the contract of the Commission with the Westinghouse Electric Corporation was modified to cover the development of a nuclear power plant suitable for the propulsion of large naval surface vessels, such as aircraft carriers, and work has now started on this project. The assembly of the land-based prototype of the submarine thermal reactor and power plant was substantially completed during the last six months at the Reactor Testing Station. Also, work got under way on the second submarine thermal reactor power plant which is for installation in the U.S.S. "Nautilus," whose keel was laid in June by the Electric Boat Division of the General Dynamics Corporation. The Knolls Atomic Power Laboratory of the General Electric Company, at Schenectady, began fabrication of the land-based prototype of the submarine intermediate reactor and its power plant. The construction at West Milton, N.Y., 18 miles north of Schenectady, of the portion of the submarine hull in which the prototype nuclear power plant will be assembled and of the 225ft diameter spherical steel building to house the hull and the reactor was well advanced at the end of the year.

In July, 1952, the A.E.C. and the U.S. Air Force agreed upon establishing at the Reactor Testing Station a ground test facility for prototype nuclear aircraft power plants. Meanwhile, at Lockland, Ohio, the Aircraft Gas Turbine Division of the General Electric Company progressed on the development of a nuclear power plant and propulsion units for aircraft.

Physical Research

The purpose of the A.E.C. physical research programme is to encourage scientific progress and to help assure the United States of adequate scientific and technical accomplishment in fields related to atomic energy. Realising that a high level of technical competence is an important resource for national security, the Commission encourages and assists basic research in atomic energy in its own laboratories and in private institutions where research is of a high quality. Approximately 24,900,000 dollars was allocated to the support of basic physical research during the 1953 fiscal year. About two-thirds of this went to A.E.C. laboratories and about one-third to universities and private research institutions.

Looking well beyond the present horizons of practical achievement, new forms of nuclear and sub-nuclear energy are now being studied and new ways of releasing nuclear energy are being examined. For these studies particle accelerators or nuclear reactors are being used to provide sub-atomic particles for probing the nucleus under investigation, and certain electronic devices are used to detect and measure the radiations emitted as a result of the probing. As the energy of the probing particle is increased above a few hundred MeV, as in experiments being conducted at a number of university laboratories under the sponsorship of the A.E.C., a new and different form of nuclear response has been observed in which energy is emitted from the nucleus in the form of particles called mesons. The large cyclotrons and synchrotrons at these institutions have been used to produce mesons on a limited basis for study in the laboratory, and work of the past year has been directed toward understanding the properties, behaviour and function of these particles. New and more powerful accelerators, the Cosmotron at the Brookhaven National Laboratory and the Bevatron being built at the University of California Radiation Laboratory, are expected to add to knowledge of this form of nuclear energy. They will facilitate bombardments with high-energy protons, with subsequent release at these energies of several new kinds of mesons which have already been discovered in

cosmic radiation, but were never before available for laboratory study.

As a basis for the engineering design of reactors and atomic weapons, knowledge is required of the affinity between neutrons and all of the different kinds of nuclei making up the substance and structure of the device. This affinity is known to vary erratically with the energy of the neutron and is different for each of the 1000 or more different types of nuclei. A "nuclear engineer's handbook" should contain several thousand pages of data listing these affinities, or "cross sections," for all of the different kinds of reactions—capture, scattering, excitation, fission—between all of the various kinds of nuclei and neutrons of all energies. This accumulation of data, even after ten years of research, is far from complete, and a major effort is now being made by the Commission to complete the tables. The nuclei which serve as reactor fuels—the fissionable isotopes of uranium and plutonium—have been studied with first priority. Next in order are uranium 238, since it is the fertile material for plutonium production, and other non-fissionable isotopes of uranium which are parasitic to the operation. Of third priority are structural materials such as aluminium, carbon, zirconium, iron and chromium, which enter into a reactor for one purpose or another. Finally, all of the other elements of the periodic table must be studied in detail for possible use in the atomic energy field.

The instruments used for these studies are of various designs depending upon the energy range within which the measurements are to be made. For neutrons of energy between 10,000 and several million electron volts, Van de Graaff accelerators are used. In the lower energy ranges, neutrons are produced by reactors or cyclotrons and their energy is determined by measuring the time of flight from a pulsating source to a detector placed some distance away. The most advanced of these instruments is the "fast neutron chopper," recently installed at the Brookhaven reactor. It is soon to begin a twenty-four-hour a day schedule of operation to facilitate the measurement of the cross sections of the nuclei of very rare materials. Instruments operating on the same principle are already in use at the Argonne National Laboratory and at the Oak Ridge National Laboratory, while others deriving their neutrons from particle accelerators are in operation at a number of university laboratories.

Since high-energy nuclear reactions can be studied by examining the tracks left in photographic emulsions on film or plates by the particles comprising cosmic rays, members of the cosmic ray group at the Brookhaven Laboratory have sent such emulsions to high altitudes by means of balloons, aircraft and rockets. At these altitudes, primary cosmic ray particles are more numerous than at ground level since they have not come into contact with air molecules to a significant extent. Such experiments are necessarily of short duration, and obtaining a set of significant tracks is largely a matter of chance. Exposure of such plates to the Cosmotron beam, however, has shown that the machine produces particles that begin to compare in energy with those of primary cosmic ray particles. In addition, the ease of access to this source of highly energetic particles multiplies enormously the number of nuclear phenomena that can be successfully recorded for examination and interpretation. A new cloud chamber design has been developed at Brookhaven in connection with cosmotron work. This chamber, which has an area eight times as large as that of conventional chambers and is capable of continuous rather than intermittent operation, is said to have an efficiency nearly 2000 times higher than chambers of conventional size. As much data is gathered in one day's operation with the new method as could be amassed in six years of operation with the old method.

When atomic nuclei are bombarded by particles of sufficiently high energy, all sizes of pieces may be "chipped" off them. This chipping-off process has become known as "spallation." One of the A.E.C. research programmes under way in this field is at the University of Rochester, where a group is studying spallation reactions resulting when various elements are bombarded in the cyclotron by protons with energies up to 250 MeV. Investigators at the Radiation Laboratory, University of California, are continuing similar investigations. It is hoped that a study of the nature and yields of the products of these spallation reactions will contribute to an understanding of this phenomenon and of high-energy reactions in general.

A number of operations in the atomic industry require the separation of mixtures of elements, sometimes very similar in their chemical behaviour, and their isolation in an exceedingly pure state These separations are often complicated further by extremely high levels of radio-activity, necessitating carefully shielded operations conducted by remote control. Investigations of the fundamental chemical properties and the behaviour of elements of interest are carried on at all of the national laboratories and by a number of university contractors. The national laboratories have the additional responsibility of developing processes for separating and purifying materials to meet specific needs, including the removal of uranium from natural source material, the purification of structural materials and moderators for nuclear reactors, the separation of the products and by-products of various nuclear reactors, and the processing of waste materials for storage or disposal.

A major part of the production operations of the A.E.C. involves the separation of isotopes —the separation of uranium 235 is a well-known and leading example. It has become increasingly apparent that research and development on methods of isotope separation must be maintained at a substantial level if new methods are to be developed. The Oak Ridge National Laboratory is now establishing a group to investigate methods of producing separated isotopes. The Standard Oil Development Company will examine on a continuing basis all methods of "heavy water" production, including those that may yet be conceived in the laboratory. Another of the separation problems of interest to the Commission is the separation of the rare earths. These elements are similar in chemical properties to the series of elements which includes uranium, neptunium and plutonium. In addition, they are generated in the fission process and knowledge of their chemistry is essential. In working on such separation methods, scientists at the Argonne National Laboratory recently developed and tested a new continuous counter-current extraction technique which promises to be feasible on an industrial scale. The large-scale isolation of single rare-earth elements in high purity also appears to be economically feasible. In the present state of development, the purity of the final product is not as great as that obtained by the ion exchange method in use at the Ames Laboratory, although significantly larger quantities may be processed. It is believed that a combination of the solvent extraction technique and the ion exchange method could produce for the first time large quantities of high-purity rare-earth elements.

The structural materials of a nuclear reactor have to withstand high temperatures and radiation. The Commission is sponsoring numerous studies at all of the national laboratories and at certain universities throughout the country on the differing imperfections in the structure of the crystals of metals produced by bombardment with both charged and uncharged particles at various temperatures. Ways and means of removing these imperfections by annealing at varying temperatures are being investigated. The aim is to develop methods of processing structural members so they will stand up at higher temperatures and greater intensity of radiation. One of the unclassified investigations under way on developing improved materials for shielding nuclear reactors is that at the University of Alabama. The group is investigating the possibility of developing enamel glasses containing high percentages of the oxides of cadmium, boron, hafnium and other neutron-absorbing metals which may also absorb gamma radiation.

Element 85, astatine, was first prepared in 1940 in America by irradiating bismuth with 32MeV alpha particles. The occurrence of astatine in nature has now been established by the discovery at the University of California Radiation Laboratory of astatine 219 as a decay product of the actinium series. Astatine has been found to have a half-life of about forty-eight seconds and to occur as less than one part per million in the decay series. Its extreme scarcity, together with the lack of knowledge of its detailed chemistry, is believed to be the reason why it has never before been detected in nature.

After its initial run in June, 1952, the Cosmotron at the Brookhaven National Laboratory underwent extensive changes and additions to correct faults which had developed in early operation and to replace temporary equipment and wiring. The Cosmotron is said to be the only machine now in operation which can accelerate nuclear particles to energies in the 2000MeV range. Protons of 3MeV to 4MeV are injected into the circular tube or vacuum chamber of this electro-magnetic machine and whirl with increasing velocity 3,000,000 times in the second required to bring them to the peak energy of 2000MeV to 3000MeV. Experimental equipment for the study of high-energy particles from the Cosmotron is now being assembled and experiments have begun.

During the last six months, the synchrotron at the California Institute of Technology succeeded in accelerating electrons to energies up to 1000MeV. This electron beam is used to bombard heavy metal plates which produces high-energy X-rays. These X-rays are then used to bombard various atomic nuclei in an effort to find out how these nuclei are constructed, what forces keep them together, and what particles are created. A linear accelerator capable of accelerating electrons to energies up to 1000MeV was unveiled in December at Stanford University. A 2MeV Van de Graaff particle accelerator was completed in October at the Oak Ridge National Laboratory, and experimental runs are being made to determine its operating performance. The 60in constant-frequency cyclotron manufactured by the Collins Radio Company for the Argonne National Laboratory was accepted by the laboratory in July. The beam of electrically charged particles which emerges from the acceleration chamber of this instrument is extremely intense, making the cyclotron especially well suited for the study of nuclear reactions and for the production of radio-active isotopes. The preliminary engineering survey for the redesign of the 184in cyclotron at the University of California Radiation Laboratory was completed during the last six months, together with certain model magnet tests. The results indicate that a proton energy of 650MeV, a deuteron energy of 350MeV and an alpha energy of 700MeV may be achieved as compared to the present energies of 350MeV, 200MeV and 400MeV, respectively. This increase will make it possible to apply higher particle energies to the study of mesons and nuclear forces. Final design work is now under way, and more precise model magnet tests employing the exact geometry of the redesigned machine will be started shortly.

Railway Electrification in Holland

RAILWAY electrification first started in Holland about a half-century ago on the line Rotterdam–The Hague–Scheveningen. In 1924, it was decided to convert the section Amsterdam–The Hague–Rotterdam to electric traction, and an extensive electrification programme has been pushed ahead since that date, and particularly since the end of the war. Amongst the electrified lines recently opened to traffic may be mentioned those from Amersfoort to Zwolle and from Zwolle towards Leewarden and Groningen via Moppel. Including these lines, the overall length of electrified network (for double-track working) amounted, by the end of 1952, to 800 miles, i.e. about 40 per cent of the whole network. The annual consumption of electric energy by the electrified railways reached in 1952 the figure of 400 million kWh. Amongst the most recent schemes the line Arnhem–Zutphen was converted to electric traction in January, 1953, and it is expected that the section Zutphen–Zwolle will be electrified in May, 1953. The addition of these two lines will bring the total length of electrified track to 860 miles.

Ore Preparation and Blast-Furnace Plant at Shotton

WE have received from Head, Wrightson and Co., Ltd., some notes on the ore preparation and blast-furnace plant supplied by that firm for the extensions of the Hawarden Bridge Steel Works, Shotton, of John Summers and Sons, Ltd.

This completely integrated plant included ore unloading, crushing and screening plant, sinter plant, blast-furnace plant, gas cleaning plant, rolling stock, together with all foundations and electrical equipment.

Initially the plant is built as a single-furnace installation with a weekly production of 4350 to 7100 tons of iron suitable for the manufacture of steel by the basic open-hearth process. Generally foreign ores will be used and with a 50 per cent iron content, the supply of 14,200 tons of ore per week will be necessary.

The ore is brought into Birkenhead by ship and is being delivered by rail to site, the ore-handling plant being capable of handling 750 tons per hour. In the ore yard the material is handled by the ore bridge which is of 180ft span, and can be seen in one of the illustrations on this page.

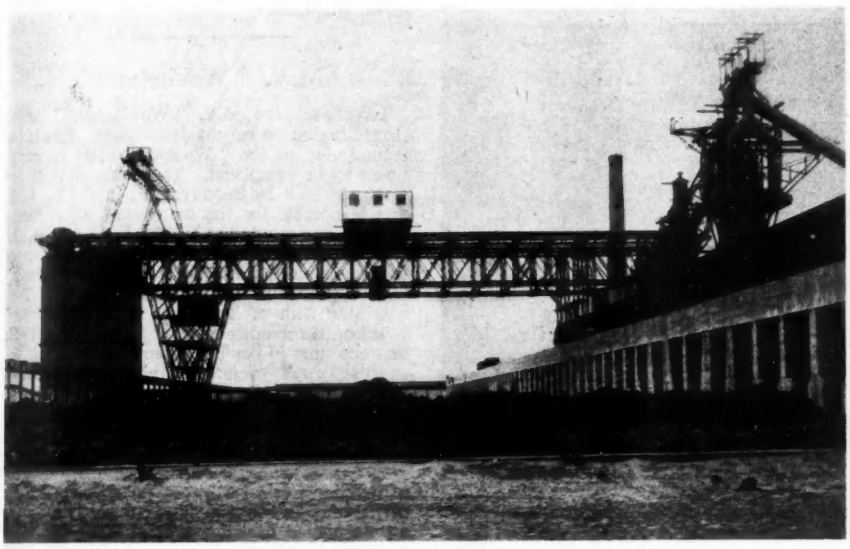
A sinter plant with a capacity of 1800 tons per day comprises one continuous strand sinter machine, 72in wide by 120ft long with twenty wind boxes, together with ancillary equipment. The twenty-eight conveyors installed will be used to transfer materials to the points required.

The blast-furnace with a hearth diameter of 27ft is the largest in Great Britain. It is fitted with a Head, Wrightson-McKee improved design distributor and the large bell has a diameter of 15ft 6in. The through truss skip bridge with a double track has two 250 cubic feet capacity skip cars.

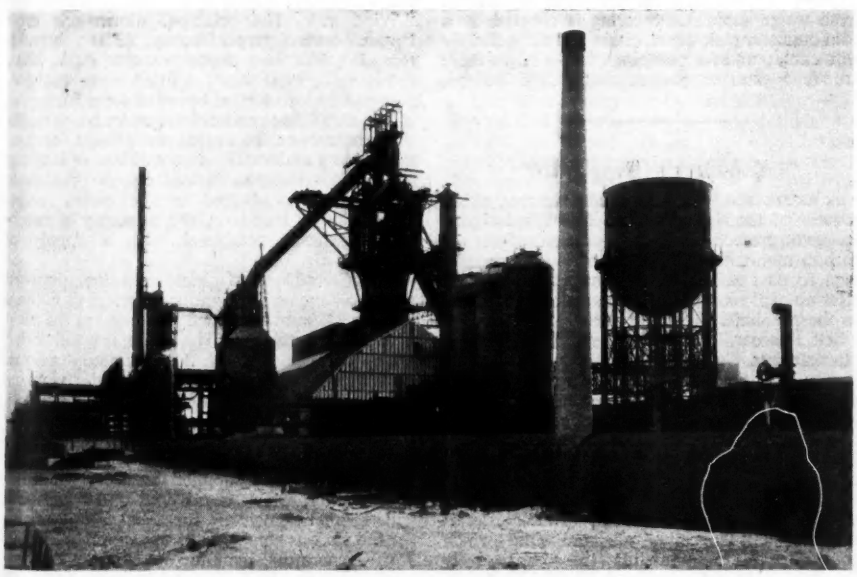
The cast house is of open floor design with concrete slab, sand fill and brick paving. A 12 cubic feet capacity "Brosius" electro-mechanical clay gun has been installed to stop the furnace tap hole.

The three hot blast stoves are 26ft diameter, 102ft high and are fitted with the Freyn design of burner.

Slag from the furnace is run directly into a pit, where it is sprayed with water. Cooled slag is removed from this pit by means of an excavator and loaded on to a dumper which conveys it to waste land. The molten ore is transferred from the furnace to a mixer or to an open-hearth furnace for converting, by means of 75 tons capacity hot metal ladles and carriages.



Ore Yard and Bridge



Blast Furnace Plant

The gas cleaning plant comprises a 16ft 10in inside diameter centrifugal dry cleaner with a 41ft 6in high straight side, and top and bottom cones ; a gas washer of 18ft inside diameter by 65ft straight side ; and two 28ft diameter shell precipitators, each having 260 tubes, which are 12in by 15ft long. The clean gas is stored in a 2,000,000 cubic feet capacity waterless gasholder.

The main items of rolling stock supplied for the installation include two 50-ton capacity ore transfer cars and two 500 cubic feet capacity scale cars.

We are informed by Head, Wrightson and Co., Ltd., that John Summers and Sons, Ltd., has placed with it the order for the No. 2 blast-furnace plant, which is now under construction.

African Engineering News

(By Our South African Correspondent)

Uranium Production in the Union Gold Mines

In addition to the direct income from uranium, the South African gold mines which produce it will, in general, be able to recover gold from ore that is uneconomic to work on the present basis. For instance, the Bird Reef on certain West Rand mines might carry as little as 2 dwt of gold or even less, and still be economic to work, because of uranium's contribution to the working costs. The same will apply to the Kimberley Reef, on the East Rand. Apart, therefore, from the contribution of the new mines coming into production, the gold output of South Africa will be increased in the next few years. The precise significance of uranium extraction to the mines is impossible to forecast, but, on the basis of results already published, the profits from uranium with twenty producers would come to some £10,000,000 per annum. There will, in fact, be more than twenty producers.

Power for the Copper Belt

In spite of the opportunity to stockpile coal during the recent strike on the copper mines of Northern Rhodesia, there is again a threatened shortage of fuel there. The planned expansion of Wankie Colliery, from which are drawn all supplies, will not be completed for some little time. It is understood that some relief for the copper mines will be given by a certain amount of electric power being made available from the new hydro-electric generating station under construction by the Congo-Belge authorities on the Luapula River. It is probable, however, that the rapidly growing needs of the Copper Belt will not be satisfactorily met until Northern Rhodesia's own natural advantages in water power are harnessed. Plans for this have recently been completed, based on damming the Kafue Gorge, as described in THE ENGINEER of February 13th last.

Building Board Factory in Natal

The £1,000,000 factory erected for the African Building Board Corporation at Canelands, on the Natal North Coast, stands on a site, 230 acres in extent, near Verulam. The main items of equipment were purchased from Sweden, considerable heavy machinery being also purchased from Britain, Germany and the United States. Moreover, £150,000 worth of locally built machinery is used in this completely automatic and interlocked plant. The factory is planned to permit extension over the site to include three mills in all, the second of which is now in course of erection.

In the initial stages it was thought that black wattle, which is abundant in Natal, might prove the most suitable timber for the purpose. Early evidence, however, demonstrated the superior qualities of the timber finally chosen—Saligna gum—the supply of which has been secured for a period of thirty years. Large tonnages of pulpwood are already on the site submerged in water in order to ensure the retention of the physical properties of the fibre.

The plant itself is economically arranged on

four floors and consists chiefly of a series of steel cutters and vibrating cylinders. These perform the task of reducing the 9ft logs into wood chips. After passing under magnets, which extract foreign metals such as nails, the chips are treated with steam, and the resulting pulp is processed and pressed into decreasingly thinner layers, spongy in texture, which are cut and trimmed to the required size. These boards are then carried by a system of conveyor racks into a hydraulic press, where, under pressure and heat, the boards are formed. Except for the addition of certain emulsions, the process depends for its success on the proper treatment and retention of the physical properties of the fibre, such as elasticity and tensile strength. The main plant is operated by no more than eight men, and that the total number of Europeans employed in the mill and workshop is thirty-six. All the technical men were recruited from the Scandinavian countries and Finland.

Light Alloy Patrol Launch

OUR illustration shows the patrol launch which has been completed recently by Grimston Astor, Ltd., of Bideford, to the order of the Burmese Government and which has been handed over following successful trials. The launch is constructed of aluminium alloy and has been built on the principle of the two-way tension system which is linked with the builders' name, and which has been referred to in THE ENGINEER, in association with other launches, and described in our issue of February 23, 1951.

Light Alloy Patrol Launch

The boat has a length overall of 55ft and a beam of 14ft 3in, while a headroom of 6ft 6in has been maintained throughout the accommodation. Twin Perkins diesel engines propel the launch at a cruising speed of 14 knots and a maximum speed of 15·25 knots in the light condition. The light displacement amounts to 6·66 tons and the designed endurance is 900 miles; during trials the launch demonstrated its manœuvring qualities by carrying out a full speed turning test to give a turning circle having a diameter of two lengths.

As arranged, the boat has a wheelhouse of ample dimensions amidships, which houses all the controls necessary for navigation purposes. Steps lead down from the wheelhouse to a single large forward cabin, which is designed to accommodate forty-five troops, while right forward is a toilet and chain locker. Moving aft from the wheelhouse, a short ladder gives access to the engine space, from which a door in the aft bulkhead opens on to the crew's quarters. This cabin is arranged to house a complement of five and includes a small space set aside for cooking purposes, and there is a separate toilet compartment.

For the hull plating, transom and floors 10-gauge material to Standard Specification N.S.5 has been used and 12-gauge sheet of the same alloy has been used for the construction of the bulkheads, while the deck plating and engine floor plates are of ¼in thick postive grip chequered plating to Specification H.P.10.W.P., all being supplied by the British Aluminium Company, Ltd. The keels and bilge keels are of 3½in by 3½in by $\frac{5}{16}$in by ¾in tee sections of H.E.5 material and the combined shaft brackets and skegs are fully heat-treated castings to Specification L.M.10.W.P., while for the castings for stern tubes and rudders L.M.6. alloy has been used.

For propulsive purposes the launch is equipped with two six-cylinder Perkins model P.6.M. diesel engines, each rated to develop 65 b.h.p. at 2000 r.p.m. They have electric starting and power is transmitted through a Mk. M.R.11.B. oil-operated reverse gearbox, supplied by Self Changing Gears, Ltd., which consists of an oil-operated clutch to provide a direct ahead drive and a similar clutch coupled to an epicyclic gear train for going astern. The gearbox is self-contained, the oil for lubrication and for operation of the clutches being supplied from the gearcase sump by an internal gear pump. Stainless steel shafting of 1¼in diameter and the three-bladed propellers of 16½in diameter by 11½in pitch, made of L.M.10.W.P. light alloy, have been supplied by Bruntons, Ltd. Closed circuit fresh water cooling has been adopted for the engines, which have single lever Teleflex controls. Two tanks, each of 185 gallons capacity, carry the necessary fuel and are housed in a compartment directly beneath the wheelhouse. Another tank of 185 gallons capacity, mounted in the aft peak, carries the fresh water supplies. Steering is effected by a 24in diameter teak wheel, chain and extra flexible wire cables, and for pumping out the bilges there are four plunger pattern flush deck pumps.

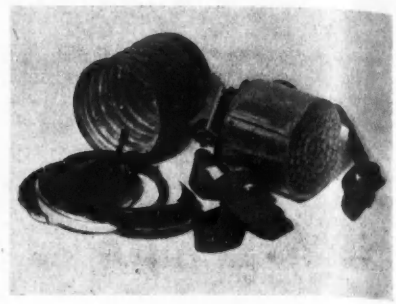
A Miner's Respirator

A RESPIRATOR which has been developed at the request of the National Coal Board is designed to give protection against concentrations of carbon monoxide for a short period and enable men to pass safely through contaminated areas after an explosion or fire when making their way to the pit shaft. This respirator, known as the "Self Rescuer," has been developed by Siebe, Gorman and Co., Ltd., Davis Road, Tolworth, Surrey. In the photograph we reproduce here one of the respirators can be seen on the right with its opened container on the left.

The respirator consists of an absorbent canister, 3½in diameter by 2¾in long, fitted with mouthpiece, non-return inhalation and exhalation valves, noseclip and a simple supporting web harness tying behind the head. The canister is filled with "Hopcalite," a compound which converts carbon monoxide to comparatively harmless carbon dioxide, and an efficient drying agent, which protects the "Hopcalite." This canister weighs 16 ounces.

A strong corrugated metal container in which the respirator is carried is sealed by a quick-release standard press cap and is painted a distinctive green. A complete "Self Rescuer" outfit packed in its container weighs about 24 ounces and the container, which is 3½in diameter by 4½in high, is fitted with a loop by which it can be carried on a miner's belt.

It is pointed out that the apparatus gives protection for about half an hour. It does not generate oxygen and will only afford protection when there is sufficient oxygen in the atmosphere breathed to sustain life. The respirator unit is at present undergoing trials at a number of pits in the coalfields.



Respirator and Container

M.V. "Wokingham"

LAST week the M.V. "Wokingham" sailed from London on her maiden voyage. She is the second ship of the "Windsor" class of cargo liners to be completed. The name ship of the class was built by Barclay, Curle and Co., Ltd., and is notable for the many new ideas incorporated into the design by Mr. E. H. Watts, the chairman of the shipowners. Some account of the improvements over the earlier "Wanstead" class appeared in our columns on March 28th and May 30th of last year. The "Windsor" sailed on her maiden voyage on October 3, 1952, and accounts of her behaviour indicate that the ship was well tried in varying conditions of weather and had proved a comfortable and good seaboat. Steering proved perfect under all the conditions encountered and the vessel always carried weather helm.

In an endeavour to eliminate the five degrees of weather helm, which the "Windsor" usually carries, and also to deal more effectively with the water shipped forward, a breakwater has been constructed abaft the forecastle on the "Wokingham." In other respects the new ship, which was built by the Caledon Shipbuilding and Engineering Company, Ltd., is a sister ship to the "Windsor." The principal dimensions are: length between perpendiculars, 435ft; breadth moulded, 58ft 6in; depth to shelter deck, 38ft; deadweight, 9950 tons; loaded mean draught, 27ft. Deep knuckles at bow and stern form part of the ship's lines and ballast tanks between the cargo hatches on the weather deck help to control the stability under different conditions of loading. The accommodation is laid out on the same generous lines adopted in the earlier ships. Ventilation is based on the principle of mechanical exhaust combined with a supply of tempered air.

A Vickers-Doxford airless injection, opposed piston oil engine having four cylinders of 670mm bore by 2320mm combined stroke forms the main propelling machinery. The engine is fitted with a Bibby detuner flywheel, to eliminate torsional oscillations in the crankshaft over the working range of speed, and is arranged to burn heavy fuel. Most of the auxiliaries are steam driven, the steam being supplied by an exhaust gas and oil-fired cylindrical boiler, while steam for the deck machinery is supplied by a second cylindrical boiler, which is oil fired and fitted with superheater elements. Electrical requirements for the various ship services are supplied by four 75kW generators, manufactured by the Sunderland Forge and Engineering Company, Ltd., one of which is steam driven and three are driven by Ruston and Hornsby diesel engines.

Industrial and Labour Notes

Steel Plate Distribution Scheme

In the House of Commons on Monday last, the Minister of Supply, Mr. Duncan Sandys, announced that it had been decided to introduce a distribution scheme for steel plate, which would be operated on voluntary lines by the steel industry itself, with guidance from the Government. This decision, the Minister stated, had been taken after discussion with the steel industry as to what action could be taken to mitigate the effects of the present shortage of plate and to ensure the best use of available supplies.

The Minister said that, for some time, the steel industry had been taking steps to increase the supplies of steel plate, and production had now risen to nearly 47,000 tons a week, compared with just over 40,000 tons weekly a year ago. It was expected that production this year would be over 2,400,000 tons, or nearly 200,000 tons more than last year, and it was hoped to increase output by a further 100,000 tons or more during 1954 and 1955. Any further substantial increase could be secured only by the provision of additional rolling capacity. In this connection, Mr. Sandys mentioned that approval had been given recently to a scheme for the extension and modernisation of a plate rolling mill on the North-East Coast which would produce an extra 100,000 tons a year. This, he said, should come into operation in 1956. Plans for other expansions were being made, but these could not become effective before 1957. There was also the possibility of importing more steel plate, and although the shortage was not confined to the United Kingdom, it should be practicable to obtain somewhat increased supplies from certain countries.

About the distribution scheme, the Minister said that an inter-departmental committee, composed of officials of the principal Government departments concerned, had been set up. Its task would be to keep under review the needs of the plate-using industries and to consider any adjustments in the pattern of production and deliveries which might be desirable. Mr. Robert Marshall, a director of Colvilles, Ltd., and a member of the Iron and Steel Corporation, had accepted an invitation to act as technical adviser to the committee and generally to assist in the operation of the scheme. The steel industry, Mr. Sandys added, had appointed a group of plate makers to act as a clearing house for consumers' requirements.

The Federation of British Industries

At the annual general meeting of the Federation of British Industries, which was held in London on April 15th, Sir Harry Pilkington was elected president in succession to Sir Archibald Forbes, who has occupied the presidential chair for the last two years. Sir Harry, who is the chairman of Pilkington Brothers, Ltd., was appointed deputy president of the F.B.I. last year.

In his address as the retiring president, Sir Archibald Forbes referred to the effort which the F.B.I. had concentrated upon the economic situation during the past year. He said that it was most satisfactory that the Chancellor of the Exchequer should have given weight to the considerations which the Federation had been urging about the need to relieve the burden of taxation so that a start could be made with the encouragement of more capital investment and the provision of some incentive to initiative and enterprise. The restoration of the initial allowances, Sir Archibald continued, would offer some assistance in the way of an immediate contribution to the financing of capital development. But he thought it should be understood that the restoration was no more than the acceleration of the allowances which would in any event be forthcoming in subsequent years, and that such immediate benefit as it conferred was at the expense of the future. Sir Archibald said that he must point out that the concession did not in any way meet the case which industry had submitted to the effect that the depreciation allowances as a whole were inadequate from the point of view of providing the resources necessary to replace fixed assets at to-day's enhanced level of cost. It was to be hoped that the restoration of the initial allowances could be regarded as a stop-gap measure pending a more real and permanent solution as a result of the deliberations of the Royal Commission on Taxation.

Later in his address, Sir Archibald spoke about the need for greater export effort. In his Budget, Sir Archibald said, the Chancellor had sought to ease the difficulties of the United Kingdom exporter by reducing in some measure the general disincentive created by crushing taxation. It was to be hoped that British industry would respond by maintaining and increasing the great effort already made. The export problem, Sir Archibald observed, must be regarded from the long-term standpoint, and in that connection one of the most important factors was the development of the resources of the Commonwealth and the Colonial Empire. At a time when there was a shortage of savings for capital investment at home, the unpalatable fact had to be faced that no more than a part of the funds required for Commonwealth and Colonial Development could, for some time at least, be forthcoming from this country. The development of Commonwealth resources, Sir Archibald added, ought to lead to the availability of more products for sale to the dollar area and to the provision of export business for the United Kingdom. But it must be realised that many problems would have to be solved in the way of creating conditions which would attract the capital. In many areas, the first requisite was the provision of such essential services as transport, communications and housing—objectives which were not so appropriate for private investment in these days.

Export Prospects

In the monthly review of the economic situation which is prepared by the information division of the Treasury, it is stated that the volume of exports shipped from the United Kingdom last year was 6 per cent lower than in 1951. World industrial activity, however, has recently been recovering and the upward trend shows signs of continuing. But, the review points out, many countries are short of foreign exchange, and restrictions against imports are still widespread. At the same time, competition has been growing, the U.S.A. has been taking a larger share of world trade, and Germany and Japan have re-emerged as major exporting nations.

The review goes on to say that the world market has become intensely competitive over almost the whole range of manufactures. The greatest importance, therefore, attaches to the continuing modernisation of industry and the expansion of capacity wherever export sales can be increased. A number of industries which are either new to the export field or where exports have rapidly expanded since 1938 accounted last year for 7 per cent of all United Kingdom exports compared with just over 1 per cent in 1938. There has been notable expansion, for example, in exports of wholly new kinds of electrical apparatus, in new and virtually new classes of machinery such as combine-harvesters and air-conditioning equipment, in the completely new export trade in diesel-electric locomotives, and in the export of aircraft and parts which rose from £5,500,000 in 1938 to £44,000,000 last year. Exports of petroleum products continued to grow in 1952, but some chemical products which had shown big increases up to 1951 did not maintain that level in 1952.

For the great part of its export earnings, the review observes, Britain must continue to look to established industries; but to maintain and increase its share of world trade requires ever new technical advances, their rapid translation into production plans, and the creation and manning of new industrial capacity. The level of scientific research and the pace of productive investment are, therefore, not least among the factors which will determine how large a share of world markets Britain can secure. Above all, however, at present and as far ahead as can be seen, the achievement of our overseas objectives must rest on the competitiveness of British industry—on price, delivery, quality and service—over all manufactures, capital goods as well as consumer goods, and old exports as well as new.

The Trade Figures for March

Figures issued by the Board of Trade show that there was a slight recovery in United Kingdom exports during March. They were valued at £212,900,000, compared with a monthly average of £206,300,000 in January and February. The total value for the first quarter, however, was still 2 per cent less than in the fourth quarter of last year. Imports increased in March to a value of £285,700,000, giving an average of £272,800,000 a month in the first quarter of this year, compared with £263,300,000 a month in the second half of last year. Re-exports in the first quarter averaged £10,000,000 a month.

In the concluding stages of the Budget debate in the House of Commons last Monday, the President of the Board of Trade, Mr. Peter Thorneycroft, spoke about the use of credit terms which British exporters were permitted to quote in foreign markets. He said that exchange control policy had recently been reviewed in order to ensure, subject to balance of payments considerations, that there were no unnecessary obstacles to exports. As the result of that review, Mr. Thorneycroft continued, exporters could be assured that they would be given greater freedom in granting credit terms which they wished to offer to overseas buyers. In so doing, exporters would naturally have regard not only to the needs of the situation, but to the financial facilities available to them. Exporters would, of course, continue to apply for the necessary permission, but they could rest assured that the Government intended to speed up the processes of control so as to give them decisions as rapidly as possible.

Coal Output

Last week's coal output showed considerable improvement, following the effect of the Easter holiday. The total amount raised was 4,755,400 tons, there being 4,519,800 tons from the deep mines and 235,600 tons from opencast workings. Thus, in the first fifteen weeks of this year, coal production amounted to 67,486,500 tons, compared with 67,024,200 tons in the corresponding period of last year. The number of wage earners on colliery books in the week ended April 8th was 720,800, of whom 300,400 were face workers. On the corresponding date last year the total number on the books was 712,200, of whom 290,300 were working at the face.

Last weekend, the Minister of Fuel and Power, Mr. Geoffrey Lloyd, visited collieries in South Wales. Speaking at Gorseinon on Friday, the Minister said that, both in the interests of those employed in coal mining and of all other people in the country, coal output needed to be increased materially as quickly as possible. That fact, the Minister continued, was recognised by the National Coal Board and the National Union of Mineworkers who had joined in an efficiency drive, for it was by increased operating efficiency at the pits that the task could be accomplished. The greater efficiency would only be achieved by a combination of technical improvement—some of which might be capable of quick attainment and some requiring longer for fruition—good management and good trade union leadership.

Notes and Memoranda

Rail and Road

DIESEL SHUNTING LOCOMOTIVES AT PARKESTON QUAY.—The Eastern Region of British Railways has recently taken delivery, from the Drewry Car Company, Ltd., of three diesel mechanical shunting locomotives for use at Parkeston Quay. Their five-speed gearboxes facilitate rapid acceleration, even with considerable loads, and compressed air brakes ensure full control under all circumstances. Each locomotive weighs approximately 30 tons, has a fuel capacity of 225 gallons, and is rated at 204 h.p. The locomotives are also equipped with vacuum exhausters for use when working vacuum-braked coaching stock or wagons. This enables them to be used for stabling the Hook and other Continental trains and the B.A.O.R. leave trains.

Air and Water

MR. P. LEDGARD.—It is with regret that we record the death of Mr. Percy Ledgard, which occurred at his home in Surrey on Sunday, April 12th. Mr. Ledgard, who was well known in shipbuilding circles, served his apprenticeship with Cochrane and Sons, Ltd., of Selby, and then moved to join the staff of Vickers, Ltd., where he stayed for six years. In 1915 he went to the North-East Coast and spent three years in the service of Swan, Hunter and Wigham Richardson, Ltd., before crossing to the south side of the River Tyne to Palmers Steel and Iron Works. Some fifteen years later he became assistant naval architect to Sir Joseph W. Isherwood and Co., Ltd., and in 1937 was appointed a director. During the war Mr. Ledgard served with the Admiralty and when released in 1945, he was appointed naval architect to the Blue Star Line, Ltd., and was closely associated with the post-war building programme which that company embarked upon to replace war losses.

Miscellanea

HIGH PRESSURE PUMPS.—At the end of the article under this heading, which appeared in our last issue, the following sentence was inadvertently omitted: "The author acknowledges the permission of the Chief Scientist, Ministry of Supply, to publish this article."

MR. H. A. LINGARD.—We note with regret the death of Mr. Herbert Arthur Lingard, which occurred at Ewell, Surrey, on April 18th, at the age of seventy. Until his retirement in 1948, Mr. Lingard had been for seventeen years a director of the British Thomson-Houston Company, Ltd., which firm he joined in 1904. For some years Mr. Lingard was the general manager of the company's lamps and lighting department. He was a former member of the council of the Electric Lamp Manufacturers' Association.

INTERNATIONAL AGRICULTURAL FAIR.—Exhibitors from fourteen countries will participate in the International Agricultural Fair which is to be held at Utrecht from April 27th to May 2nd. It is stated by the organisers—the Royal Netherlands Industries Fair—that the Fair will stress the mechanisation of modern agriculture and horticulture. It will include 422 exhibits and give a complete view of the international production of machines, tools and accessories for agriculture, horticulture and poultry farming.

MR. FREDERIC POOLEY.—We have learned with regret of the death of Mr. Frederic Pooley, M.I.E.E., which occurred in London on April 19th, at the age of eighty-one. Mr. Pooley, whose long career was spent in the electrical engineering industry, was educated at Liverpool University, and served a pupilage with the Liverpool Electricity Supply Company. In his earlier years, he held appointments with the National Telephone Company, W. T. Glover and Co., Ltd., and St. Helens Cable Company, Ltd., and, early in 1907, founded, with Mr. Austin, the firm of Pooley and Austin, electrical engineers, in Westminster. Mr. Pooley was also a director of the Key Engineering Company, Ltd., P.A.M., Ltd., and Refrigerator Components, Ltd.

NON-DESTRUCTIVE TESTING OF STEEL CASTINGS.—A conference on "The Non-Destructive Testing of Steel Castings," arranged by the British Steel Castings Research Association, was held at the Engineering Centre, Glasgow, on April 22nd. Dr. R. Hunter, joint managing director of the Clyde Alloy Steel Company, Ltd., was in the chair. The purpose of this conference was to present the results of the Association's development work related to radiography, and to radiological scanning in particular, and to consider the present and future application both of ultrasonic testing and of xero-radiography in relation to steel castings quality control. An exhibition of the latest ultrasonic testing equipment was also organised by the Association and was opened to the public immediately after the conference.

TERMINATION OF THE SULPHUR COMMITTEE.—The Sulphur Committee of the International Materials Conference has announced that its member governments have agreed to the dissolution of the committee as from April 30th. This announcement follows the committee's recent decision to discontinue the international allocation of crude sulphur and reflects the continuing improvement in the supply and demand position. The Sulphur Committee, which was the second of the commodity groups to be established within the framework of the International Materials Conference, met for the first time on March 1, 1951. The committee's recommendations for the first international allocations of crude sulphur were accepted by its member governments for the third quarter of 1951 and allocations were continued on a quarterly or half-yearly basis until March 1st last.

NOTCH BAR TESTING.—In December, 1951, the Institute of Welding, in collaboration with the Joint Committee on Materials and their Testing, organised a symposium on "Notch Bar Testing and its Relation to Welded Construction." Twenty-six technical societies are represented on the joint committee. The symposium consisted of five papers, which have now been reproduced in book form, together with the spoken and written discussion on them. Two of the papers presented the viewpoint of the steelmaker and three the viewpoint of the user. The book is available, at 25s., from the Institute of Welding, 2, Buckingham Palace Gardens, London, S.W.1.

STATISTICAL SUMMARY OF THE MINERAL INDUSTRY.—A new edition of the *Statistical Summary of the Mineral Industry*, formerly published for the Imperial Institute, covers the seven-year period 1945 to 1951, and is now available at £1 7s. 6d. from H.M. Stationery Office. Comprehensive details are given of the production, imports and exports of some sixty minerals and metals, arranged in alphabetical order. World totals for a number of minerals are incorporated for the first time. In accordance with the practice in former editions, production tables for copper, lead, tin and zinc show output of ore in terms of metal as well as smelter production. A section on coal deals with coke, briquettes and the chief coal by-products, while that on petroleum is concerned with crude petroleum, natural gasoline, natural gas, asphalt, oil shale and the chief refinery products. The iron and steel section gives information on iron ore, pig iron, ferro-alloys, and steel.

INCORPORATED PLANT ENGINEERS' CONFERENCE.—The sixth annual conference of the Institution of Incorporated Plant Engineers is to be held at the Palace Hotel, Southport, on May 20th, 21st and 22nd. On the first evening, Wednesday, May 20th, there is to be a civic reception and ball, at the Floral Hall, Southport, and on Thursday morning, at 9.30 a.m., the annual general meeting of the Institution will be held at the Palace Hotel. Mr. J. C. Tremayne will be installed as president and will deliver his address. The remainder of Thursday will be devoted to the presentation and discussion of papers dealing with the general theme of "Management and the Plant Engineer." The conference dinner will take place at 8 p.m. on Thursday evening. On Friday morning, May 22nd, there is to be a further technical session, beginning at 9.30 a.m., followed at 1.15 p.m. by a "leave-taking" luncheon. Full details of the conference arrangements are available from the secretary, Mr. H. S. Seaborne, 48, Drury Lane, Solihull, Birmingham.

COMBUSTION ENGINEERING ASSOCIATION.—The annual conference of the Combustion Engineering Association is to be held at the Palace Hotel, Buxton, on Thursday and Friday, May 7th and 8th. The papers to be presented for discussion are as follows: Thursday at 10 a.m., "The Advantages and Disadvantages to the User of Delivered Prices for Coal," by Mr. R. J. Moffat; at 2.30 p.m., "Improving the Efficiency of Existing Boiler Plants," by Mr. H. E. Partridge; Friday at 9.45 a.m., "The Relative Merits and Applications of Different Methods of Firing Water-tube Boilers with Solid Fuel and the Effect on Rating of the Use of Low Grade Fuels," by Mr. W. C. Carter; at 2.30 p.m., "Oil as a Main and Supplementary Fuel for Firing," by Mr. A. Kenyon. A conference ball will be held on Thursday evening, May 7th, at 8.30 p.m. Full details of the conference arrangements are available from the Combustion Engineering Association, 6, Duke Street, St. James's, London, S.W.1.

IRON AND STEEL ENGINEERS' MEETING.—The Iron and Steel Institute announces that a meeting of junior engineers (below the age of thirty-five) is to be held at Ashorne Hill, Leamington Spa, from Monday to Thursday, May 11th to 14th. At the opening session on May 11th two papers on "Oil Injection Shrink Fitting," by Mr. J. A. Abrahams, and "Steel Works Waste-Heat Boilers," by Mr. R. McDonald, will be read and discussed. On May 12th and 13th visits will be paid to the Round Oak Steel Works, Ltd., Dudley, and to the British Thomson-Houston Company, Ltd., Rugby, each visit being preceded by a lecture on the works. The concluding item in the programme is a lecture, on the morning of May 14th, by Dr. T. P. Colclough on "The First and Second Five-Year Plans for the Iron and Steel Industry." Full particulars of the meeting can be obtained from the Iron and Steel Institute, 4, Grosvenor Gardens, London, S.W.1. The meeting is open to non-members as well as members of the Institute.

YORKSHIRE FIRM'S CENTENARY.—We have received from James Austin and Sons (Dewsbury), Ltd., a copy of an illustrated book which it has recently prepared to record its history during the first century of its existence. The firm celebrated its centenary in 1950. The firm was started by James Austin, who, as a young man, moved from Stanningley, Leeds, to Dewsbury, to work as a whitesmith for James Greenwood, at Eastfield Mills. In 1850 Austin started his own business in quite a modest way, taking up successively the manufacture and stocking of various iron products. James Austin died at the age of seventy, in 1892, but the business which bears his name has developed from its small beginnings to its present size and status. With its headquarters at Thornhill Works, Dewsbury, the firm has, through the years, added structural engineering to its iron and steel stock-holding activity, and has as its subsidiaries Astley, Brook and Co., Ltd., of Huddersfield, and A. J. Riley and Son, Ltd., of Batley. Mr. Norman Shaw is the present chairman of the parent company. Among the excellent illustrations included in the book are several describing the factory building and other structural engineering contracts completed by the firm in recent years.

FRENCH STEELWORKERS' VISIT.—Two technical missions which are shortly to visit the United States of America have arrived from France to spend a few days in this country, during which they are seeing some major works in Wales. It was suggested to the steel industry by the French authorities that it would be of great value to members of these two missions if they could be given this opportunity, particularly as terminology and language are the same in both British and American steelworks.

Personal and Business

MR. J. HAROLD WOOD has been appointed technical director of B. Thornton, Ltd., Huddersfield.

MR. G. AINSWORTH WATES has been appointed a director of Johnson and Phillips, Ltd., Charlton, S.E.7.

THE BRITISH TRANSPORT COMMISSION states that Mr. Eric Coleby, legal adviser to the Railway Executive, will retire on May 9th.

MR. E. MORGAN has been appointed senior liaison engineer in the components division of the Plessey Company, Ltd., Ilford.

THE DARLINGTON FORGE, Ltd., states that Mr. J. Duthie has been appointed a director and Mr. R. C. Benson a special director.

THE AJAX MACHINE TOOL COMPANY, Ltd., states that its goodwill and assets have been transferred to Ada (Halifax), Ltd., Johnson Street, Halifax.

VICKERS, Ltd., announces that Mr. L. J. B. Forbes, Fourth Floor, 165, Bloor Street East, Toronto, 5, has been appointed its general representative in Canada.

THE MINISTER OF SUPPLY has appointed Mr. S. Scott Hall as head of technical services, British Joint Services Mission, Washington, in succession to Sir Alwyn Crow.

MR. A. L. HANCOCK has been appointed a director of Walker, Crosweller and Co., Ltd., Cheltenham, and of its subsidiary, the Arkon Manufacturing Company, Ltd.

WILLIAM CURRIE AND CO. (RUBBER MANUFACTURERS), Ltd., Edinburgh, has appointed Marshall-Howlett, Ltd., 44–45, Tower Hill, London, E.C.3 (telephone, Royal 1461), as its London agent.

THE MINISTRY OF MATERIALS announces the appointment of Mr. R. F. Rucker as Director of Non-Ferrous Metals, in succession to Mr. C. A. James. Mr. Rucker will begin his duties on May 1st.

COAST LINES, Ltd., announces that Commander R. T. Park, O.B.E., R.D., R.N.R. (Retd.), who has been chief marine superintendent of the company since 1935 will retire at the end of the month.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., has opened a new branch office at 14–16, Baldwin Street, Bristol, 1 (telephone, Bristol 27000). Mr. J. H. Beaumont Robins is manager in the Bristol area.

THE BRUSH A.B.O.E. group announces the formation of Brush Electrical (Australia) Pty., Ltd., with head offices in Sydney, N.S.W. Mr. V. J. Chalwin is the chairman and managing director of the new company.

THE MOTOR GEAR AND ENGINEERING COMPANY, Ltd., Essex Works, Chadwell Heath, has taken over from B. and P. Swift, Ltd., the manufacture and marketing of the Swift "Motogear" and worm reduction gears.

NEWMAN INDUSTRIES, Ltd., Yate, Bristol, announces the appointment of Mr. R. F. Shearman as technical representative in the U.S.A., and of Mr. R. J. Shawyer as general manager of Newman Industries (Australia) Pty., Ltd.

ROSE, DOWNS AND THOMPSON, Ltd., Hull, states that it has made an agreement with Merz Patents, Ltd., Wylde Green, Sutton Coldfield, for the manufacture and sale of Merz solvent extraction plants. Mr. Victor Merz has joined Rose, Downs and Thompson, Ltd.

THE LAPOINTE MACHINE TOOL COMPANY, Ltd., 111, New Street, Birmingham, states that Mr. Lance Rutter has been appointed to assist the sales director in the Midlands and on the Continent. Mr. Arthur Hollen has succeeded Mr. Rutter as northern representative.

HANDLEY PAGE, Ltd., Cricklewood, N.W.2, announces that Mr. R. S. Stafford, chief designer since 1945, has been appointed director of the technical department, Dr. G. V. Lachmann has been appointed director of scientific research, Mr. C. F. Joy, chief designer, and Mr. G. H. Lee, deputy chief designer.

Contracts

THE HUNSLET ENGINE COMPANY, Ltd., Leeds, has received an order for three 0–8–0T locomotives of 48 tons weight and 3ft 6in gauge for the Gold Coast Railways.

THE STEEL COMPANY OF WALES has placed with Simon-Carves, Ltd., a contract to the value of more than £2,250,000 for new coke ovens in connection with the £40,000,000 steel works extension programme at Margam, South Wales. The new plant will comprise ninety compound regenerative ovens with a throughput of 1650 tons of coal per day, together with associated coal and coke handling equipment and a new by-product plant to produce crude tar, crude benzole and sulphate of ammonia. The new oven battery will be built parallel to the existing line of Simon-Carves coke oven batteries, but on the opposite side of the existing by-product plant. Clearing of the area has started, and delivery of materials to the site is expected to begin in the near future.

British Patent Specifications

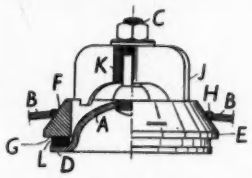
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

STEAM GENERATORS

688,867. October 19, 1950.—MANHOLES FOR STEAM BOILERS, Otto Afflerbach, Puderbach, Westerwald, Koblenz, Germany.

The invention relates to closures for handholes and manholes in steam boilers and compressed air containers, the aim being to provide a closure suitable for high pressures, the reinforcing ring being of such form as to obviate the necessity for an inside weld. The drawing shows a closure comprising a drop-forged reinforcing ring. The elliptical cover *A* of the closure, which is curved away from the interior of the container *B*, has the form of a segmental arch in the direction of the major axis of the ellipse and a three-centred or basket-handle arch in the direction of the minor axis. At the centre of the cover a clamping bolt *C* is secured and the cover has a peripheral flange *D*, the upper face of which is employed as a sealing face. The reinforcing ring *E* is constructed as a solid drop-forged part. It has a peripheral conical seating face *F* and a diametral



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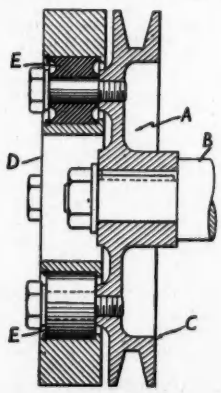
sealing face *G*. The conical seating surface of the reinforcing ring *E* bears firmly against the edge of the hole in the wall of the container and the edge face of the wall bordering the hole is bevelled so that, together with the adjacent part of the conical seating surface of the ring, it defines a V-shaped annular groove for the weld seam *H*. The angle of taper of the reinforcing ring is chosen so that the internal forces are suitably transmitted from the ring to the container wall and so that the symmetrical weld joint has the necessary strength to meet all requirements. The means for applying the clamping pressure comprises a stirrup *J*, four bracing arms extending from a central eye *K* with the outer ends of the arms bearing on the top of the reinforcing ring at points spaced symmetrically around it. The eye engages over the bolt *C* connected to the centre of the cover and by screwing up the nut the sealing flange of the cover is pulled up strongly against the gasket *L* between this flange and the sealing face of the reinforcing ring.—*March* 18, 1953.

VIBRATION ABSORBERS

688,888. September 18, 1951.—VIBRATION ABSORBERS, Morse Chain Company, 7601, Central Avenue, Detroit, Michigan, U.S.A. (*Inventor: Earl Fred Riopelle*).

The invention relates to vibration absorbers for crankshafts of reciprocating engines. As the drawing indicates, the vibration absorber *A* is mounted on the end of a crankshaft *B*. It comprises a pulley *C* for a



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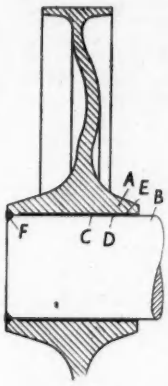
fan belt which is keyed to the shaft. The pulley is attached to the inertia member *D* by means of a number of resilient and flexible members *E* interposed between the pulley and the inertia member, which allows that member to vibrate in the vertical and horizontal planes, as well as about the centre line of the shaft, thereby allowing the energy which would normally vibrate the shaft to be absorbed by vibrating the inertia member. The drawing shows the general construction of the vibration absorber, and in the specification a drawing is given showing the natural frequencies of engine crankshafts, and the changes effected by the vibration absorber.—*March* 18, 1953.

RAILWAY ENGINEERING

688,943. November 23, 1950.—WHEEL SETS FOR RAIL VEHICLES, Bochumer Verein für Gusstahlfabrikation Aktiengesellschaft, Stahlhauserstrasse 20, Bochum, Germany.

By the use of the invention a reinforced nave seat can be eliminated, so that it is particularly suitable for interior-mounted wheel sets. It further provides for connecting the nave and axle on the outside by a circular welding seam. The drawing shows a radial section of an interior-mounted railway wheel set made according to the invention, with a welded connection to the outer end of the axle. The nave *A* is forced on to the axle *B* which has the same diameter throughout. An intermediate layer *C* of a material having anti-friction properties, such as tin, galvanising or plating, or polyvinyl resin products, is provided between the nave seat *D* and the inner wall *E* of the nave bore. This intermediate layer extends over the whole length of the force fit connection, and is in the



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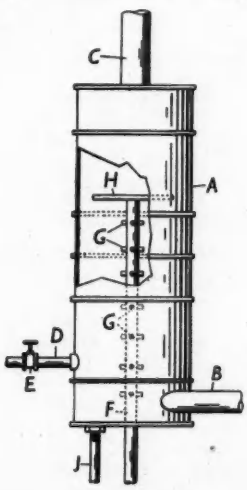
form of a thin sleeve, but it would be sufficient if it were arranged only in the danger zone—somewhere about 30mm outwards from the inner nave edge. The axle and nave are connected together at the outer ends by a circular welding seam *F*.—*March* 18, 1953.

DUST SEPARATORS

689,165. January 4, 1949.—DUST SEPARATORS FOR THE SCRUBBING OF GASES, British Celanese, Ltd., Celanese House, 22/23, Hanover Square, London, W.1.

Referring to the drawing, the gas scrubber comprises a cylindrical shell *A* with a gas inlet *B* through which a fume or dust-laden gas may be introduced, and a gas outlet *C* at the top through which the cleaned gas is removed. Gas inlet *B* is tangential to shell *A* so that the entering gas stream follows a



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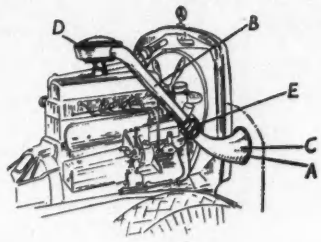
helical path as it travels up the shell. A second gas inlet pipe *D* having a valve *E* can be used for the introduction of any other gas that it is desired to wash or to be absorbed in the scrubber simultaneously with the treatment of the gas entering inlet *B*. The absorption of the acid fumes or the scrubbing of any dust or other solid particles from the gas entering through inlets *B* and *D* is effected by a spray of finely divided liquid from a manifold *F* with a number of spray nozzles *G* attached. A baffle plate *H* at the top of manifold forces the upward-moving gases to pass close to shell, causing water droplets entrained in the gases to be separated in the open portion of shell above disc *C*. The aqueous solution, or the slurry of solid particles, formed during the gas washing operation falls to the base of the shell and is removed through discharge or drain pipe *J*.—*March* 25, 1953.

ROAD TRANSPORT

688,932. July 28, 1950.—AIR-INTAKE FOR VEHICLE ENGINES, Daimler-Benz Aktiengesellschaft, Stuttgart-Unterturkheim, Germany.

The invention relates to motor vehicles, more especially commercial vehicles, equipped with diesel engines. In the off side front wing there is, as the drawing indicates, an air intake opening covered by a grid or mesh *A*. This opening admits air to two-



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part duct *B* and *C*, which leads to an air filter *D*. The two duct parts are connected together by a rubber sleeve *E*. In operation the air drawn in by the engine, uninfluenced by the temperature in the engine space behind the radiator, enters the grid and flows through the duct to the filter.—*March* 18, 1953.

AGRICULTURAL ENGINEERING

689,456. August 5, 1949.—HOPPER FEED MECHANISMS, Arthur Edgar Jervis, Roundhill Farm, Tusmore, near Bicester, Oxfordshire.

The invention relates to hopper feed mechanisms, and is designed for agricultural hopper feed mechanisms for distributing manures and fertilisers, but can be used in cement hoppers. Referring to the drawing, there is mounted vertically in the hopper an agitating member in the form of a straight length *A* of round iron bar which continues into a conical-helical portion *B*. The straight length is sufficient to extend down over the whole length of the neck of the hopper, centrally through the normal valve to the centre of the distributing disc beneath the hopper. The straight end of the bar is threaded at *C* and

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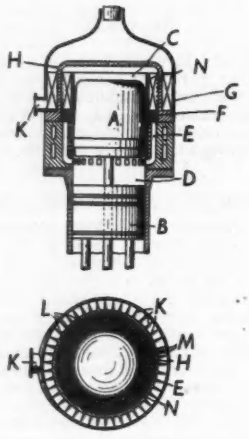
passes through a central hole in the disc. Nuts on the bar clamp the disc between them so that the agitating member is driven by the disc and supported at a height which can be adjusted by altering the positions of the clamping nuts. The conical-helical part *B* of the bar is central and vertical in the hopper, starting at a point a little above the neck of the hopper and increasing in diameter as it extends upward. Two short transverse valve clearing bars *D* and *E* are welded to the straight portion of the agitating member, one being positioned to be just above the hopper valve and the other being just below it. Additional short transverse bars *F* are provided between the upper valve clearing bar and the beginning of the conical-helical part, these bars being as shown at progressively increasing angles to the upper valve clearing bar in the same direction as that in which the spiro-helical part is "wound." Also, a number of very short pointed bars or "teeth" *G* are provided above the bars at or near the beginning of the conical-helical part, these teeth projecting more or less radially. The direction of the "thread" of the conical helix and the direction of drive are such that when rotated, the conical helix gives a screwing action tending continuously to lift the material in the hopper. In this way the material is prevented from packing the hopper neck and obstructing stones or other "lumps" are prevented from being jammed

against the valve. The upper valve clearing bar *D* and the angular bars *F* above it assist in the lifting action, while the "teeth" *G* help in breaking up any small lumps thrust upwards by the bars beneath them. The inward bending of the extreme upper end encourages feeding of the material in the hopper centrally upwards.—*March* 25, 1953.

HEAT EXCHANGERS

689,484. August 14, 1950.—HEAT EXCHANGERS FOR HOT-GAS ENGINES, N.V. Philips' Gloeilampenfabrieken, Emmasingel 29, Eindhoven, Holland.

The hot-gas engine comprises a displacer *A* and piston *B* reciprocating with a constant phase difference and connected to a driving mechanism. The space above the displacer is the hot space *C* and the space between the displacer and the piston is the cold space *D*. These spaces are interconnected through a cooler *E*, a regenerator *F*, and a heater *G*. The heater has a cylindrical wall *H* over the exterior of which the combustion gases pass. These gases are supplied



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from a tap burner to the heater *G* and escape from it through a connection *J*. As shown, the wall *H* is provided with external ribs *K* and segments *L* are provided which jointly constitute a cylinder extending throughout the interior periphery of the wall, at least a part of the segments having channels *M* through which the air to be heated passes, and which terminate at the cylindrical inner surface of each segment. All opposed side walls of the channels (two of each defining one channel) extend parallel to one another in each segment. In order to separate the hot space from the space within the heater a cylinder *N* is provided within the segments. The heat exchanger can also be used in other apparatus.—*March* 25, 1953.

Technical Reports

Caustic Cracking in Marine Scotch Boilers. (Report No. 79, R.B. 536, revised.) By W. McClimont, B.Sc., A.M.I.Mech.E. The British Shipbuilding Research Association, 5, Chesterfield Gardens, Curzon Street, London, W.1.—"Caustic cracking" is the term used to describe the intercrystalline fractures which occur occasionally in boiler components under the influence of static stress and in contact with fairly concentrated solutions of caustic soda. Four factors are required to produce such cracking and they are: (*a*) boiler water containing a caustic alkali; (*b*) high and unhomogeneous stresses in the metal; (*c*) very slow leakage or other processes causing concentration of caustic alkali at highly stressed points; and (*d*) contact of the concentrated solution with highly stressed boiler metal. Published information on these factors is discussed. It is concluded that, although much laboratory work has been done on the mechanism of failure, thirty years' practical experience on land boilers has produced no conclusive evidence on factors tending to induce or inhibit attack. A number of recommendations are, however, made arising from the foregoing work, and the survey of existing information includes an extensive list of references.

A Survey of Electric, Hydraulic and Friction Couplings for Use in Geared Propulsion Units (Report No. 68, R.B. 473, second revision). By W. J. R. Roach, B.Sc. The British Shipbuilding Research Association, 5, Chesterfield Gardens, Curzon Street, London, W.1.—Four designs of coupling are reviewed, namely, the electromagnetic coupling, the air-operated friction clutch, the oil-operated friction clutch, and the hydraulic coupling. No consideration has been given to electric drives and torque converters, as they are considered to be more in the nature of substitutes for gearing. The basis for comparison has been taken to be: (*a*) characteristics when used as a clutch; (*b*) flexibility of transmission; (*c*) acceptability of misalignment; and (*d*) efficiency of transmission. A tabular comparison is given enabling the advantages and disadvantages of each design to be assessed. A description and some diagrams of each design of coupling are given, together with details of some modifications which have been made for special purposes, and an attempt has been made to indicate the suitability of the various couplings for conditions likely to be met in service. It should be noted that the electric slip coupling, the oil-operated friction clutch and the hydraulic coupling are well established for marine drives both in this country and abroad, but the air-operated or pneumatic clutch is less well known, having come into prominence during the war, when it was used extensively under the arduous service conditions obtaining in large and small invasion craft. This form of coupling would appear to be worth serious consideration for propulsion drives in vessels such as tugs and coasters.

Launches and Trial Trips

AJASA, self-trimming collier; built by Hall Russell and Co., Ltd., to the order of the Crown Agents for the Colonies on behalf of the Nigerian Government; length between perpendiculars 330ft, breadth moulded 46ft, depth moulded to upper deck 21ft 6in, deadweight 4000 tons on 19ft 3in draught; four holds, steam deck machinery; triple expansion steam reciprocating engine, 1850 i.h.p., taking steam at 220 lb per square inch from three cylindrical boilers burning West African coal under forced draught. Trial, April 2nd.

MIDDLESEX, refrigerated cargo liner; built by Alexander Stephens and Sons, Ltd., for the Federal Steam Navigation Company, Ltd.; length 469ft 6in, breadth 64ft 6in, depth 42ft, deep load draught 27ft 4in; gross tonnage 8230; five cargo holds, 10-ton capacity derricks and one 50-ton derrick; two 10-cylinder Sulzer oil engines, each of 4500 s.h.p. at 225 r.p.m., engines geared to one shaft through B.T.H. magnetic couplings and gearing supplied by Power Plant Company, Ltd., arranged to burn boiler oil; four 300kW Ruston and Hornsby generators. Trial, April.

LONGFELLOW, cargo ship; built by Henry Robb, Ltd., Leith, for the Rodney Steamship Company, Ltd.; length between perpendiculars 335ft, breadth moulded 50ft, depth moulded to upper deck 26ft 6in, deadweight 5500 tons on 21ft 10in mean draught, speed 11 knots; Sulzer diesel engine, five cylinders, 2000 b.h.p. at 155 r.p.m.; three 106kW Sulzer diesel-driven generators. Launch, April 14th.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

CHEMICAL SOCIETY

Thurs., April 30th.—Burlington House, Piccadilly, London, W.1, "The Scientific Problems of Surface Catalysis," H. S. Taylor, 7.30 p.m.

Thurs., May 7th.—Burlington House, Piccadilly, London, W.1, Meeting for the Reading of Original Papers, 7.30 p.m.

HULL CHEMICAL AND ENGINEERING SOCIETY

To-day, April 24th.—Church Institute, Albion Street, Hull, Annual General Meeting, 7.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

Wed., April 29th.—Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, Discussion on "The Lighting of Pedestrian Crossings," opened by A. J. W. McIntosh, 6 p.m.

INCORPORATED PLANT ENGINEERS

To-day, April 24th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, "The Approach to Maintenance," H. G. Hilton, 7.30 p.m.

Thurs., April 30th.—S. YORKSHIRE BRANCH: Grand Hotel, Sheffield, Film and Discussion on the Making of Glass, 7.30 p.m.

Tues., May 5th.—LONDON BRANCH: Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2, Ladies' Evening, "Running a Hotel," E. C. S. Price, 7 p.m.

Wed., May 6th.—SOUTHAMPTON BRANCH: Polygon Hotel, Southampton, "Pumps and Pumping," J. B. Scivier, 7.30 p.m. ——S. WALES BRANCH: S. Wales Institute of Engineers, Park Place, Cardiff, "Modern Electrical Control Systems," 7.15 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., April 29th.—LONDON BRANCH: Waldorf Hotel, London, W.C.2, Annual General Meeting, followed by Films, "New Methods for Old" and "Avec Le Feu Sacré," 7 p.m.

INSTITUTE OF ECONOMIC ENGINEERING

Sat., May 2nd.—The Christian Institute, 70, Bothwell Street, Glasgow, Scottish Regional Annual General Meeting and Members' Papers, 10.30 a.m.

INSTITUTE OF FUEL

Tues., April 28th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, "Refractory Recuperators," A. L. Roberts, 5 p.m.

INSTITUTE OF MARINE ENGINEERS

To-day, April 24th.—JOINT MEETING WITH THE BARROW ASSOCIATION OF ENGINEERS: Technical College, Barrow-in-Furness, "Ships that Serve Ships," T. Clark, 7.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Mon., April 27th.—SCOTTISH CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, Annual General Meeting, 7.30 p.m.

Tues., April 28th.—N.E. OF ENGLAND GROUP: Royal County Hotel, Durham City, Annual General Meeting, followed by Film Show, 7 p.m.

Wed., May 6th.—E. MIDLANDS CENTRE: Mechanics' Institute, Nottingham, Centre Annual General Meeting, 7.30 p.m.

Fri., May 8th.—S. WALES GROUP: S. Wales Institute of Engineers, Park Place, Cardiff, "The Wilson Gearbox in the Field of Commercial Transport," A. Gordon Wilson 7 p.m.

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS

Wed., April 29th.—Horse Shoe Hotel, Tottenham Court Road, London, W.1, Annual General Meeting, 11.15 a.m.; Annual Luncheon, 12.30 for 1 p.m.

INSTITUTION OF CIVIL ENGINEERS

To-day, April 24th.—YORKSHIRE ASSOCIATION: Great Northern Station Hotel, Leeds, Annual General Meeting, "The Examination, Assessment, Repair, Maintenance, and Renewal of Old Railway Bridges," A. Dean, 7 p.m.

Tues., April 28th.—ROAD MEETING: Great George Street, Westminster, London, S.W.1, "The Design of Motorways," T. E. Hutton, 5.30 p.m.

Tues., May 5th.—RAILWAY MEETING: Great George Street, Westminster, London, S.W.1, "The Design and Equipment of Modern Mechanised Marshalling Yards," R. E. Sadler, 5.30 p.m.

Thurs., May 7th.—STRUCTURAL AND BUILDING MEETING: Great George Street, Westminster, London, S.W.1, Discussion, "Would the Strength Grading of Ordinary Portland Cement be a Contribution to Structural Economy?" Introductory Notes by Edward Burke, L. J. Murdock, F. M. Lea and F. S. Snow, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Tues., April 28th.—MEASUREMENTS AND SUPPLY SECTIONS: Savoy Place, London, W.C.2, "Meter Problems and Consumers' Load Characteristics," L. B. S. Golds and P. Schiller, 5.30 p.m.

Wed., April 29th.—SUPPLY SECTION: Savoy Place, London, W.C.2, "An Assessment of the Impregnated Pressure Cable," L. G. Brazier, D. T. Hollingsworth and A. L. Williams, 5.30 p.m.

Mon., May 4th.—S. MIDLAND CENTRE: James Watt Memorial Institute, Great Charles Street, Birmingham, "Telemetering for System Operation," R. H. Dunn and C. H. Chambers, 6 p.m.

Tues., May 5th.—N. MIDLAND CENTRE: British Electricity Authority, 1, Whitehall Road, Leeds, 1, Annual General Meeting, 6.30 p.m.——S.W. SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, Annual General Meeting, 7 p.m.

Wed., May 6th.—S.E. SCOTLAND SUB-CENTRE: Heriot-Watt College, Edinburgh, Annual General Meeting, 7 p.m.

Thurs., May 7th.—UTILIZATION SECTION: Savoy Place, London, W.C.2, "Research in the Electrical Manufacturing Industry," L. J. Davies, 5.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS

Wed., April 29th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, Informal Discussion on "Operating Problems on Colonial Railways," 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, April 24th.—GENERAL MEETING: Storey's Gate, St. James's Park, London, S.W.1, "The Problem of Fuel Oil Ash Deposition in Open-Cycle Gas Turbines," A. T. Bowden, P. Draper and H. Rowling, 5.30 p.m.——SOUTHERN BRANCH: The University, Southampton, Annual General Meeting, followed by a Film Show, "Britain Awakes," 7 p.m.

Sat., April 25th.—YORKSHIRE BRANCH, GRADUATES' SECTION: The University, Leeds, Annual General Meeting, "Memories of Men, Machines and Materials," E. C. White, 2.30 p.m.

Tues., April 28th.—E. MIDLANDS BRANCH: Technical College, Lincoln, Annual General Meeting, 7.15 p.m.

Fri., May 1st.—GENERAL MEETING: Storey's Gate, St. James's Park, London, S.W.1, "An Experimental Single-Stage, Air-Cooled Turbine," Part I, "Design of the Turbine and Manufacture of Some Experimental Internally Cooled Nozzles and Blades," J. Reeman and R. W. A. Buswell; Part II, "Research on the Performance of a Type of Internally Air-Cooled Turbine Blade," D. G. Ainley, 5.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Tues., April 28th.—LONDON GRADUATE SECTION: 36, Portman Square, W.1, "The Factories Act as it Affects the Production Engineer," Mr. Stockbridge, 7.15 p.m.——LUTON SECTION: The Pink Room, W. H. Allen, Sons and Co., Ltd., Queens Engineering Works, Bedford, "Rolling Mill Equipment and Practice," L. P. Underwood, 7.15 p.m.

Wed., April 29th.—SHREWSBURY SECTION: Walker Technical College, Oakengates, Salop, "Incentives," B. M. Sixsmith, 7.30 p.m.

Fri., May 1st.—YORKSHIRE GRADUATE SECTION: Works Visit to Dawson, Payne and Elliott, Ltd., Otley, 6.45 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

To-day, April 24th.—MIDLAND COUNTIES BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham, "Reinforced Concrete Foundations and Structures for Blast-Furnaces and Materials and Handling Plant at Shotton, near Chester," O. W. Jones, 6 p.m.

Wed., April 29th.—LANCASHIRE AND CHESHIRE BRANCH: Reynolds Hall, College of Technology, Manchester, Annual Business Meeting, Films, "British Steel," and "A Plan Takes Shape," 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS

Wed., May 6th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Some Notes on the Technique of Casting Aluminium Billets by the Semi-Continuous Process," E. Mitcheson, 7 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, April 24th.—Mining Institute, Neville Hall, Newcastle upon Tyne, "The Use of Heavy Fuels in Diesel Engines of Marine Auxiliary Sizes," J. Smith, 6.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Tues., April 28th.—Manson House, Portland Place, London, W.1, "A New Method of Electrical Recording Suitable for Multi-Channel Working," S. S. Carlisle, 6.30 p.m.